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ARMED FORCES CHEMICAL JOURNAL

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IN THIS ISSUE. ARTICLES ON:

Civil Defense Aspects of BW and Nerve Gas
Agricultural Research for National Defense
New Thinking on Military Procurement

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SIGNALLING FOR HELICOPTER AMBULANCE
(See Article on Colored Smoke)

JANUARY-FEBRUARY, 1954

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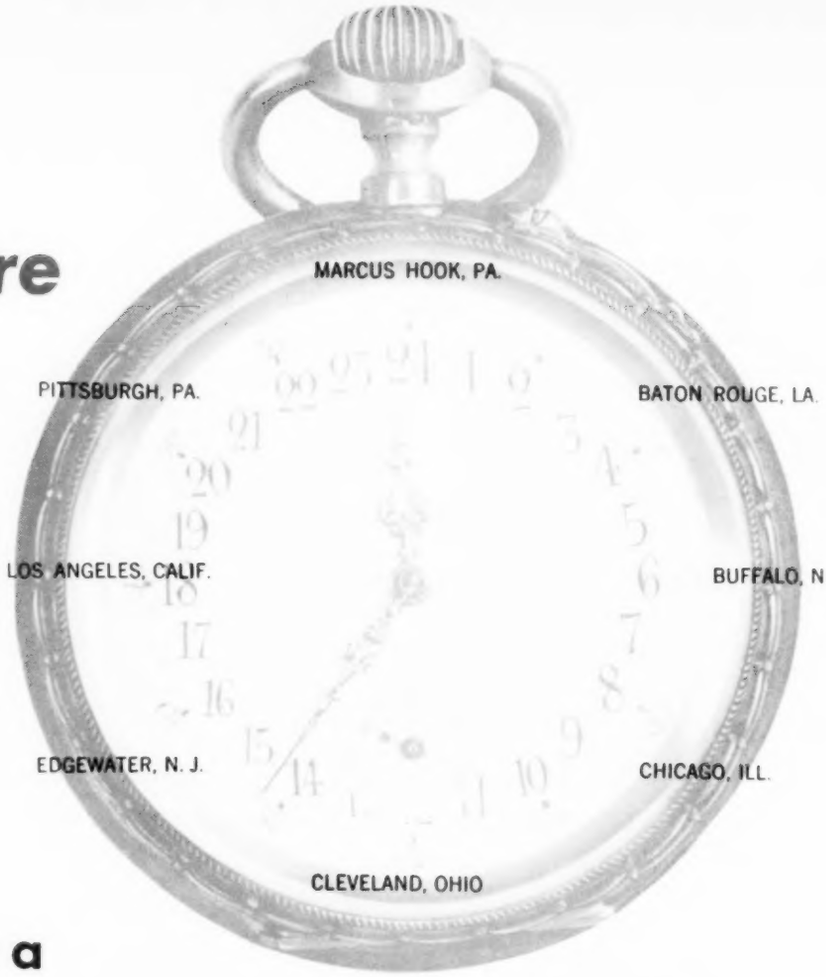

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COVER PHOTO

In Korea, 16,000 casualties were airlifted from battlefields by Army aviation helicopters. Picture shows use of colored smoke grenade in training at Army Chemical Center, Md., to signal location of wounded man to helicopter ambulance pilot.

Editor: COL. JOHN C. MACARTHUR, USA, (Ret.)
Associate Editors: COL. L. WILSON GREENE, Cml. C., USAR
MAJ. JOHN F. CARROLL, Cml. C., USAR
Editorial Consultant: LT. COL. H. B. RODIER, AUS, (Ret.)

The Armed Forces Chemical Journal is the official publication of the Armed Forces Chemical Association. The fact that an article appears in its columns does not indicate the approval of the views expressed in it by any group or any individual other than the author. It is our policy to print articles on subjects of interest in order to stimulate thought and promote discussion; this regardless of the fact that some or all of the opinions advanced may be at variance with those held by the Armed Forces Chemical Association, National Officers, and the Editors.

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Bi-Monthly Journal—In accordance with a recent decision of the President and Executive Committee, this is the first issue of the A.F.C.A. Journal as a bi-monthly magazine, replacing the former quarterly Journal.

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A MESSAGE TO THE A. F. C. A. FROM THE CHIEF OF STAFF OF THE ARMY

GENERAL M. B. RIDGWAY

UNITED STATES ARMY
THE CHIEF OF STAFF

17 November 1953

Dear Colonel Munchmeyer:

I recently wrote to the Association of the U. S. Army, of which I have long been a member, to express my view of the importance of the Association's work and to encourage its continued support by all of us in the Army.

I also want to express my great interest in your association and every association which is dedicated to advancement in the fields of the various arms and services of the Army. I know of no more significant bond between men and women who have the progress of our Armed Services at heart than to be fellow members and supporters of these outstanding organizations. To join an association of this nature and participate actively in its functions means to promote cooperation and good will, to exchange and disseminate valuable professional information, to develop esprit and mutual respect - in effect measurably to strengthen the national capability for defense.

In particular, I want to emphasize the role of the association journals. These journals not only make a significant contribution to current thinking in the arms and services but provide a unique opportunity for the professional development of the contributing members.

I strongly urge the support of these fine military associations and their outstanding publications.

Sincerely,

M. B. RIDGWAY
General, United States Army
Chief of Staff

Colonel L. W. Munchmeyer, USAR
President
ARMED FORCES CHEMICAL ASSOCIATION
2025 Eye Street, N. W.
Washington 5, D. C.

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CIVIL DEFENSE AGAINST BW

A Message from Our A. F. C. A. President

In the December edition of our Chemical News, I took note of the numerous recent articles in the daily press and national magazines concerning nerve gas, and in my comments sought to point up the importance to us of being sure that our country is able to counter with the best possible defense against such a weapon. You will note that there are articles in this issue of the Journal dealing with gas, particularly with reference to Civil Defense.

Along with this threat, we must face another potential weapon that—if anything—is even more dangerous. It is BW. Walter Winchell recently reported: "Russia's ace in the hole is not the hydrogen or the atomic bomb—it is germ warfare. It now enjoys 'triple A' priority. Russia's second top weapon is gas." I do not know, of course, where he got his information, nor do I, in the case of others who have commented editorially on the fact that the Soviets consider the atom and hydrogen bomb their No. 3 or 4 priority items. Nor do I know whether or not this is the way they rate their new weapons. It would be rather difficult for me to rate artillery, air-power and the rifle. They all have their place. At any rate, in my opinion, if we have a major conflict we will be faced with chemical, biological and atomic warfare wherever the enemy considers such means tactically advantageous.

When we speak of the rifle as a military weapon, we do not think of non-combatants becoming casualties. In the case of artillery operations, there is, of course, more of a likelihood of injury to civilians. However, when we come to air bombing and the concept of direct attack on civilian communities, we know there are bound to be a very great number of non-combatants on the war casualty lists. And certainly the prospect of gas warfare and use of atomic weapons add enormously to the grimness of this picture. But beyond this, it seems to me that biological warfare, should we ever have to contend with that, would present an even greater threat to our civilian population. It would be much more of a threat to civilians, as I see it, than it probably would be to our military forces.

Civil Defense is part of our national strength. Aside from its application to our communities generally, it is intimately associated with the safety programs of our vital industries and, of course, is directly related to military developments. It, therefore, is pertinent to the aims and purposes of the A.F.C.A. to give attention to the Civil Defense program in the columns of our publication, The Journal, which now becomes a bi-monthly magazine. Our Editor is in full accord with this policy, and will seek to follow through in future issues by including matter of Civil Defense concern. I repeat my comment in the last issue of our News—Lend your support to your local Civil Defense group.

L. W. Munchmeyer

A. F. C. A. ANNUAL MEETING PLANS

As announced in the December issue of the A.F.C.A. "Chemical News," the dates for the annual spring meeting of the Association have been changed from June 3 and 4 to May 20 and 21.

President L. W. Munchmeyer states that this change was made in view of the fact that the Manufacturing Chemists Association, many members of which are also members of the A.F.C.A., will be holding their spring meeting at White Sulphur Springs, Va., during the first week of June. Obviously, this confronted the A.F.C.A. with a serious conflict of dates, and it was decided, therefore, to readjust our plans.

Vice-President Harry A. Wansker, in charge of meetings, announces that the U. S. Air Force has very kindly agreed to act as host for our annual meeting. In responding to the Association's invitation, which was extended verbally by Mr. Wansker, officials said the Air Force would be delighted to assume this role. The request to the Air Force was made pursuant to an established custom of the A.F.C.A. to call upon one of the Armed Services each year for its special support and aid in connection with the annual meetings. The Air Force, aside from its concerns with respect to chemical means of warfare, is, of course, deeply interested in the progress and growth of the chemical industry, so great are the applications of chemistry and metallurgy in aircraft production and operation.

While details as to speeches and speakers for the meeting have not yet been worked out, this broad mutual interest insures a fertile field for important subject matter, which will undoubtedly find expression in the program.

It is of interest to note that Mr. Oliver F. Johnson, chemical engineer of Washington, D.C., deputy to Mr. Wansker on the committee and who accompanied and assisted Mr. Wansker in his meetings with Air Force officials, is the brother of Lt. Gen. Leon Johnson, Commanding General, Continental Air Command, with headquarters at Mitchell Field, L.I. In extending the A.F.C.A.'s invitation to the Air Force to act as the Host Service, Mr. Wansker called upon and talked over the project with a number of Air Force officers in the Pentagon. These included Major Gen. Wm. E. Hall, Special Assistant to the Chief of Staff of the Air Force for Reserve Forces; Col. Chas. A. Brown, Chief of the Liaison Division, Office of Public Information, his deputy, Lt. Col. Marvin Alexander, and Lt. Col. John O. Gray in charge of Reserve Forces Information. While certain details remain to be worked out, it may be said that the A.F.C.A. is assured of an enthusiastic helping hand from the Air Force in making this meeting a success.

No Change in Place of Meeting

In changing the time of the meeting from that previously announced, the Association was fortunate to be able to arrange mutually agreeable dates with The Shoreham, despite its heavy advance bookings for meetings at the hotel next May. Shown on this page is an air-view of this great hostelry which is one of the landmarks of the nation's Capital. The Shoreham is the scene of many diplomatic and other social functions in Washington. It is one of the largest hotels in the country, has 14 ballrooms, many dining places, cocktail lounges, special suites and spacious corridors making it ideal for the Association's purposes. Neither downtown nor very far either from the city's center, the Shoreham is conveniently located near the junction of Calvert Street and Connecticut Avenue and overlooks part of Washington's unique Rock Creek Park.

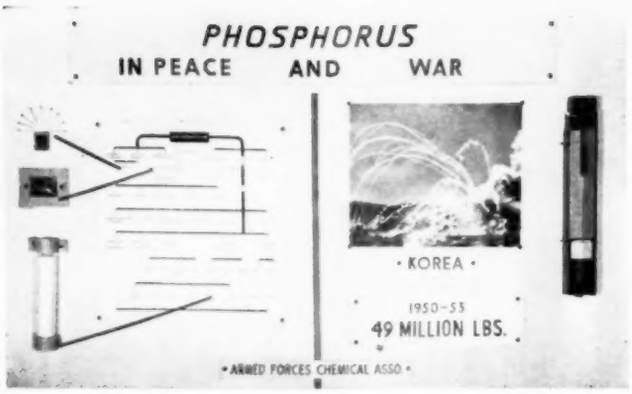
In connection with advance planning for the A.F.C.A. banquet to be held on the night of May 21, Mr. Wansker hopes that many of our group members will sponsor company tables. These will each be set for 10 persons. He hopes that in addition to attendance by many of he top officials of these industrial concerns, a large number of junior executives will come to this gathering. In launching the company-table project, Mr. Wansker is pleased to announce that his firm, the United Carr Fastener Corporation of Cambridge, Massachusetts, has taken two tables. Decision as to the registration fee for the meeting has not yet been made, pending more complete estimates of the costs involved. Present thinking is that each of the principal events of the two-day program, namely the banquet, cocktail party, etc., should be covered by separate tickets to allow members to select those features they wish to take advantage of and to pay for accordingly. A special arrangement as to tickets for active duty military personnel and civilian government employees is under consideration in order to make the meeting as attractive as possible to them.

The program committee wishes to emphasize the fact that this meeting provides an excellent special reason for our members to visit the nation's Capital, and at a time when it will be at the peak of its spring beauty.

(Continued on Page 7)

Air view of the Shoreham, Washington, D.C., where the next A.F.C.A. Annual Meeting will be held May 20-21.

One of the handsome corridors of the Shoreham.



A.F.C.A. exhibit at the Manufacturing Chemists Association luncheon, showing some of the uses of phosphorus in peace and war, designed and assembled by Colonel Kuhn.

THE CHEMICAL INDUSTRY IN NATIONAL DEFENSE

This report on the recent luncheon given by the Manufacturing Chemists Association in Washington, D. C., with some of the highlights of the address by Mr. R. Lindley Murray, President of Hooker Electrochemical Company, was prepared for the Journal by

HARRY A. KUHN, Colonel USA (ret.)
Chemical Consultant, Washington, D. C.

A luncheon meeting sponsored by the Manufacturing Chemists' Association, Inc., for members of the overall chemical and rubber industry advisory committee of the Department of Commerce and prominent government and military officials, was held at the Statler Hotel, Washington, D. C., on December 14. A feature of the meeting was an exhibit illustrating the major segments of the Chemical industry directly producing military items. The A.F.C.A. and the Chemical Corps were both represented by exhibits.

Sinclair Weeks, Secretary of Commerce, made informal remarks on the role of the chemical industry in the national economy. He was followed by the principal speaker, Mr. R. Lindley Murray, President of the Hooker Electrochemical Co., a sustaining member of the A.F.C.A.

Mr. Murray stated, "The chemical industry is a complex industry involving the production of thousands of chemicals on a commercial scale. It ranks sixth among the manufacturing industries in the country with an annual value of product amounting to roughly, 20 billions of dollars. It is outranked only by food, iron and steel, petroleum and coal products, machinery, and automobiles and automobile equipment. Actually, chemical processing plays a vital part in several of the industries which outrank it.

"In war," said Mr. Murray, "a primary job of the chemical industry is to step up its efficiency by producing larger amounts of regular and new products and to simplify production by finding new methods and new products. Application of chemicals continuously improves the weapons and equipment of the Armed Forces.

"Practically every product of the chemical industry goes to modern war in some respect. Some of its war products, like certain branches of the Armed Forces, work at the front. Just as each front line fighter can function only if he is supported by rear echelon and service troops, so chemicals which are used in combat must be backed up by a vast network of products and services which the chemical industry supplies.

"The thousands of commercial products of the chemical industry have a wide variety of defense functions. It has been estimated that 200 different chemicals are required to outfit an infantry platoon; 1,500 individual chemicals to launch a battleship.

"An incomplete survey revealed 86 different chemical products from a single plant going into a B-29 Superfortress. One chemical company counted 325 different military items which required its plastics.

"Special alloy steel to withstand the terrific heat and pressures of jet engines are made by adding such chemically-processed alloying metals as chromium, nickel, tungsten, and vanadium. The Air Force's B-36D, latest model of the world's largest bomber, has a gross weight of 358,000 pounds. Almost 20,000 of its pounds are magnesium. This magnificent airship is a vast improvement over the heavy long-range bombers of 1940, which used only 1,000 pounds of this light metal."

"The chemical industry," further stated Mr. Murray, "must now be reckoned among the greatest industrial forces of all time. In increasing and improving its own products and their applications, as well as those of other industries, it generates incalculable power for the nation's economy in peace or war.

"America's defense potential derives from the vitality of the industrial economy. Implicit in this power is the capacity to create better and more food, housing, clothing and higher living standards than men and women have ever had before; the advancing ability to prevent and check disease, fortify and prolong life, relieve suffering; and at the same time to keep ourselves so well armed that any aggressor will be deterred.

"Dr. Vannevar Bush has pointed out that should the United States again become involved in global war, we could not hope to match the forces in manpower which might be arrayed against us; in mere nose-count we would be far out-numbered. 'We can prevail,' Dr. Bush warns, 'only by a superiority in the use of weapons of defense and offense that will multiply our manpower effectiveness beyond anything an enemy can achieve.'

"Major responsibility for maintaining technological advantages over a potential enemy will rest on the chemical industry. The production of stronger, faster, tougher, lighter-weight weapons and all the supporting goods and services, depends upon products of our research laboratories.

"We recognize that with the growing complexity of business, it is necessary for industry and the government to work closely together. I have mentioned some of the problems our industry faces. Industry is optimistic about the future and if allowed to develop under a free enterprise system, the opportunities for increasing our productive capacity should continue at a rate sufficient to give us an increasing standard of living and defense materials far in excess of those that can be produced by any other power.

"The chemical industry's faith in America has been

(Continued on Page 7)

GENERAL BLACK RETIRES

Brig. General Henry Maris Black, Commanding General, Cml. Corps Materiel Command, with headquarters in Baltimore, Maryland, retired from active duty on December 31, 1953, after more than 36 years service in the Army.

It is announced that Colonel Marshall Stubbs, Chief of the Research and Development Division in the Office Chief Chemical Corps, Department of the Army, has been designated as the replacement for General Black.

General Black was born in St. Helena, Calif., May 24, 1894. He attended Pennsylvania State College for a year and then entered the U. S. Military Academy from which he was graduated August 30, 1917, and commisioned in the Coast Artillery Corps. He served in the Coast Artillery Corps until January, 1921, and after attending the Chemical Warfare School was transferred to the Chemical Warfare Service on March 10, 1921.

Following a tour as chemical warfare officer, Panama Canal Department, General Black, in June, 1926, was appointed assistant chief of the Personnel Section in the Office of the Chemical Warfare Service, and in September he entered the Army Industrial College. Upon graduation he enrolled at Harvard University and received the degree of Master of Business Administration prior to World War II.

Among his subsequent assignments were duty at Edgewood Arsenal as assistant chief, and later chief, of the Procurement Planning Division, and duty in Office of the Chief of the Chemical Warfare Service, first as assistant chief and afterward chief of the Manufacturing and Supply Division.

In August, 1938, General Black returned to Edgewood Arsenal as chief of Arsenal Operations and in May, 1943, he became chief of Arsenal Operations at Pine Bluff Arsenal, Ark. From February 1, to March 31, 1944, he was in command at Pine Bluff Arsenal, afterward resuming his former position there. In May, 1945, he took command at the Vigo Plant, Terre Haute, Ind., and the following November became commander of Camp Detrick, Md. In March, 1946, he was named commanding officer of the New York Chemical Procurement District.

In November, 1946, General Black was appointed chief of the Supply and Procurement Division in the Office of the Chief of the Chemical Corps. He moved to the Army Chemical Center, Edgewood Arsenal in January, 1947, and in October, 1950, was designated Assistant Chief Chemical Officer for Materiel. He assumed command of the Chemical Corps Materiel Command at Baltimore, Md., in October, 1951.

General Black was promoted to the grade of Colonel (temporary) in February, 1942, and received permanent appointment in that grade in March, 1948. He was made a Brigadier General (temporary) in July, 1951. He has been awarded the Legion of Merit and the Army Commendation Ribbon.

A.F.C.A. ANNUAL MEETING PLANS

(Continued from Page 5)

Suggestions Are Invited

The committee would appreciate suggestions from members or their wives as to any special facilities which the Association might provide in helping to make this occasion of interest and value to the ladies.

President Munchmeyer has, subject to their acceptance named the following to assist Mr. Wansker in the planning and execution of the program as here indicated:

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THE CHEMICAL INDUSTRY IN NATIONAL DEFENSE

(Continued from Page 6)

well expressed, I think, in its willingness to borrow hundreds of millions of dollars with which to build for the future better living of our people and to maintain and expand the great industrial machine which remains our most powerful defensive weapon.

"The chemical industry is the heart of our great industrial system. In peacetime its products are essential to every phase of our daily lives and in wartime they are indispensable."

JOHN C. MACARTHUR, *Editor*

NERVE GAS AND ACHILLES' HEEL

(The views of the editor expressed here do not purport to reflect necessarily the official opinions of any agency of the United States Government.)

In an address to the Washington chapter printed in this issue, Assistant Secretary of the Army Slezak referred to the military establishment as a division of our insurance system. While the analogy is not a new one, it seems especially appropriate in the situation today.

We willingly pay a high premium for this insurance which has stood us so well in the past, though we hope not to have to borrow against it again, as for Korea, or to have to cash in the full policy, as for World War II. However, great as this military insurance is, we know that today it is not sufficient. Dedicated as we are to peace and in the face of modern technical developments, we must have additional coverage—Civil Defense. The premium here means some of everyone's time and effort as well as money.

It is to this part of the national insurance system that these comments apply, and they start with this question: In transition to the atomic age, are we concentrating so much in our home defense thinking on the problems of the atomic bomb that we are not giving due heed to another weapon of strategic importance, namely, gas—NERVE GAS?

Is the defense structure we are building to be left with an *Achilles' Heel*, a weak spot which invites attack there, should we, in our time, ever have to face war again?

* * * * *

Defense, whether considered from the viewpoint of the civilian population or in military operations, is a broad term. An attacker can look over his stock of available weapons, make his choice and select those he wants to use. He need not confine himself to his most powerful, his most destructive weapon; indeed, it may not entirely suit his purposes. He may have another one he believes better adapted to the particular object he has in view. A defender on the other hand, if he is to have any certainty of succeeding, must take account of his enemy's entire arsenal. He must prepare not only against any maneuver the enemy can make but against any weapon of importance that he knows the enemy can throw against him. As a homely example: Of what use is it to a man to put burglar alarms on the windows of his house if he leaves the door unlocked?

If our home defense is to be realistic, it must cover any type of attack we know or have full reason to believe a potential enemy could make against our cities and people.

Defense against gas is a separate and distinct procedure. It takes time to develop and co-ordinate it with other programs.

Doctor Defandorf, pharmacologist and consultant of the Civil Defense Administration, writing in this issue, sees the possibility of nerve gas being used at least in conjunction with atomic bomb attacks on our cities to "compound" the A-bomb effects. Certainly they would be compounded if we were unprepared for chemical attack.

* * * * *

In World War II the Allied readiness and potential for retaliation prevented enemy resort to gas. The "gas war" of that period was fought out in laboratories and plants. Possibly to this day, not all of the results of this work have come to public knowledge. But we know that one important result was nerve gas, a German development.

The term nerve gas is applied to a group of compounds reportedly discovered by a German chemist in search of a new insecticide. Considerable information about these extraordinarily dangerous chemicals, including their formulas, has been published since the war. Certainly, they are known about throughout the military world.

The physical properties and physiological action of nerve gases and the medical treatment of nerve gas casualties have been described in some detail in our own open, official literature. The Civil Defense manual, "Health Services and Special Weapons Defense" printed in 1950 and reprinted in 1952, devotes some ten pages to these chemical agents. Their medical aspects are also dealt with extensively in a medical manual of the Army on treatment of chemical warfare casualties. It is sufficient to say here that these agents are extremely dangerous, practically odorless and, hence, difficult to detect, and provision of suitable gas masks is essential for protection against them. Medical studies have shown that the prompt injection of atropine is effective in the treatment of casualties.

But the medical references cited above, while they indicate nerve gas is of strategic importance, they do not provide a definite appraisal of the potentiality of the weapon for long range air attack in comparison with other means. For such thinking one must go to other sources.

Colonel John R. Wood, Chairman of the Medical Research and Development Board, Office of the Surgeon General U.S. Army, and formerly Chief,

Medical Division, Army Chemical Center, Maryland, described the medical aspects of nerve gas at some length in an open address before a meeting of the American Medical Association in San Francisco in June, 1950. With respect to the older types of chemical agents which generally must be used in great quantity for effective results, Colonel Wood at that time noted their impracticability for use in attack on this country unless the enemy possessed nearby air bases. Subsequently, in an article entitled "Chemical Defense," published by the Journal of the American Medical Association, Colonel Wood indicated the Civil Defense procedures he considered necessary for dealing with the nerve gas threat. At the start of this article he said:

"Civil defense agencies must be prepared to deal with all probable types of attack but must be especially alert to those types that are capable of inflicting heavy damage from long range. Among the latter are air attacks with the newer chemical warfare agents.

"I do not believe that any chemical warfare agents except the nerve gases are adequate for long range attack."*

While no longer on duty with the Chemical Corps, Colonel Wood is unquestionably one of our principal medical authorities today on this subject.

In the early days of our post-war civil defense project, public discussion and thinking about the atomic bomb frequently emphasized the possibility of the sneak raid by a small number of aircraft, even a single plane. It is to be noted, however, the current estimate of Soviet capability for air attack on this country, at any rate that stated in the 1952 Annual Report of the Civil Defense Administration, assumes an initial operation with about 400 airplanes. Of this number it is assumed 70% could penetrate our defenses to reach their targets. Whatever may be the case for nerve gas in small air operations, in providing for defense against hostile attack of such magnitude as here referred to, the question of nerve gas, at least as a supplement to A-bomb loads, certainly warrants full consideration.

* * * * *

Recent magazine articles which deal with Civil Defense have brought sharply to public attention this question of the strategic importance of nerve gas. In Collier's, issue of November 27, 1953, Mr. Cornelius Ryan with an article entitled "G-Gas—A New Weapon of Chilling Terror," presents the case as definitely one with which our home defense must be concerned. He states that he spent nearly a month at the Army Chemical Center preparing his subject and cites opinions of chemical warfare experts. Indeed, this writer sees the possibility of the nerve gas load of a single heavy bomber, stated as seven tons, producing a cloud, which under favorable meteorological conditions, might carry in effective concentration over a very extensive area, perhaps 100 square miles.

In another recent magazine article by Jhan and June Robbins in the November 15 issue of the Sunday newspaper magazine, "This Week," entitled "The Truth About Nerve Gas," the authors say some military men consider this gas is perhaps nearer to being the ideal weapon than the fission bombs.

An article dealing with the history and chemistry of German nerve gas development and giving the formulas of the three nerve gases referred to as Tabun, Soman, and Sarin, is contained in the November 9, 1953 issue of "Chemical and Engineering News," published by the American Chemical Society. This article is a report of an address by Mr. Bo Holmsted, Swedish chemist of the University of Uppsula, before the meeting of the Society's Baltimore section on the Chemistry and Pharmacology of Nerve Gases.

It is believed the public now, in consideration of any new weapon, is more likely to respond to calm reasoning than to a scare approach. Probably it would be helpful to the civil defense for the public to be given an official appraisal of nerve gas in terms of its considered value for long range attack on cities, its casualty effectiveness unless protective measures are taken. Admittedly the variable factors in gas-warfare make for difficulty here but this should not preclude such a statement as would promote understanding.

No doubt it has taken much time in the development of our Civil Defense to bring about in the minds of our people a reasonable degree of understanding of the atomic problem. But if nerve gas is also a definite threat, the program will be dangerously incomplete unless it includes chemical defense measures also.

* * * * *

It has now been disclosed that the Army Chemical Corps has developed gas masks designed for civilian use and has made these designs available to the Civil Defense authorities. Some pictures of one of these types of experimental masks are shown in this issue.

For adequate defense against chemical attack, certainly gas masks are indispensable, but along with protective equipment there must be gas discipline and understanding which only comes with education and training. Chemical warfare lends itself greatly to psychological attack. Conceivably, the consequences of ignorance and panic could be as bad if not worse, perhaps, than the gas itself.

In facing up to this question, we will do well to heed the warning on gas left to his country by General of the Armies, John J. Pershing, in his "Final Report" on World War I. As true today as it was when he wrote it thirty years ago is his terse conclusion:

"Whether or not gas will be employed in future wars is a matter of conjecture, but the effect is so deadly to the unprepared that we can never afford to neglect the question."

*Journal of the American Medical Association, Vol. 145, No. 16, Apr. 21, 1951, pgs. 1264-69.

COLORED SMOKE

By Robert D. McLeod, Jr.*
Colonel, Chemical Corps
Historical Office
Office of the Chief Chemical Officer
Army Chemical Center, Maryland

This article on the history and use of colored smoke grenades shows the ancient origin of pyrotechnic signals in warfare, and how through the use of organic dyes modern chemical science has contributed to these important munitions.—Ed.

The picture on the cover of the magazine shows the use of colored smoke grenades to guide an ambulance helicopter on an errand of mercy. One of the outstanding features of the Korean conflict has been this use of helicopters to evacuate the wounded, the first war in which this has been done. The use of colored smoke grenades developed by the Army Chemical Corps proved to be absolutely indispensable in marking the pick-up zones where the wounded had been assembled for the pilots of the helicopters. Hundreds of United Nations soldiers owe their lives to the prompt medical assistance made possible by the use of helicopters, guided to their rendezvous by colored smoke grenades.

Since the roads in Korea are very poor and overcrowded it has been necessary to use air support to the maximum, and the use of colored smokes has been an essential ingredient for the proper liaison of ground and air forces. As in World War II colored smoke has been used to indicate drop zones for the delivery of supplies by air, and in many cases the only way that troops could receive supplies was by aerial delivery. While in Korea, the 187th Airborne Infantry Regiment found the use of colored smoke quite necessary for the success of their operations, and always used colored smoke grenades to mark the drop zones.

The Republic of Korea troops were particularly fond of colored smokes as a means of signalling. The Koreans were acquainted with the Japanese use of colored smoke and accepted it as a standard means of battlefield communication. They found colored smokes of special value in signals to Allied supporting troops, where the language barrier made any other form of communication difficult if not impossible.

Allied troops of all nationalities found colored smoke of great value in marking enemy areas for the purpose of directing the fire of our artillery or naval vessels on those points. It is doubtful if close support of such fire for our troops could have been satisfactorily obtained by any other means.

Confusion of the Chinese

One unexpected angle on our use of colored smokes was the reaction of the Chinese Communist troops. Their political officers had taught them that war gases came in three colors, red, green, and yellow, which correspond to the standard markings of our chemical ammunition. As a result every time colored smoke grenades were used, the Chinese troops would mask and accuse the United Nations forces of using gas. The nuisance value of this belief was probably quite high. A number of Chinese prisoners of war claimed that the Chinese used captured smoke grenades to train their troops in defense against Chemical Warfare. This probably helped to strengthen the belief of the Chinese soldiers that the colored smoke grenades contained toxic agents.

When the fighting broke out in Korea there was an ample supply of colored smoke grenades on hand. Throughout the fighting violet was one of the favorite smoke colors. The airborne troops in the United States were also very fond of violet grenades. Despite the demand for smoke of this color the manufacture of violet grenades has been discontinued, and the violet grenade is no longer standard. While the reasons which prompted this order are not known it is believed that they should be re-evaluated. Possibly some person in a key position observed violet smoke against an unsuitable background and decided that violet was of no value in any situation.

Considerable complaint has been received from the using services as to the high percentage of duds found in the use of smoke grenades. This was usually caused by a failure of the fuze assembly or of the starter mixture. It is believed that strenuous efforts should be made to improve the performance of these grenades. When the lives of many men may depend upon the proper functioning of a grenade it is not too much to ask that every precaution be taken to eliminate the possibility of duds.

Early Use of Pyrotechnics

The colored smoke grenade is the latest member of the great family of pyrotechnics. In the earliest times smoke signals or fires were used to warn of the approach of an enemy. Our own American Indians evolved a special aptitude for sending messages by smoke. The use of pyrotechnics for display purposes developed many centuries ago in China and India. The Chinese amused themselves with firecrackers, colored fires, and other spectacular effects. Firecrackers were even used to some extent in war, but more as a pyschological weapon than as a casualty producer. The Romans brought back from India the knowledge of the manufacture of pyrotechnics, and many exhibitions of fireworks were held in the Roman Arena. The fall of Rome to the barbarians put an end to the development of pyrotechny in Europe until the Fifteenth Century, when there was a revival in the

*The author of this article obtained his information from the following sources:
Military pyrotechnics by Henry B. Faber.
A monograph on Colored Smokes by Leo Finkelstein.
Unpublished manuscripts from the files of the Historical Office, Office Chief Chemical Officer.
Interviews with various officers who served overseas.
Personal experience.

art which has continued to the present time. A glance at the pyrotechnics of the Eighteenth Century reveals the ancestors of many of our present day fireworks such as fire pots, sky rockets and spin wheels.

For a time the large volumes of smoke produced by black powder made the use of smoke signals in war impractical. However, by 1900, when black powder had largely been superseded by smokeless powder, work was started by both the French and Germans on illuminating shells and at the start of World War I both sides had a variety of munitions employing colored smokes and flares. These included signal pistols, rifle lights, rockets, position or ground signals, bombs and shells.

Yellow Smoke in World War I

In the United States, prior to World War I, a few military pyrotechnics had been procured by the Signal Corps, the Corps of Engineers and the Coast Artillery Corps. On 27 September 1917 the Trench Warfare Section of the Ordnance Department was assigned the responsibility for the design, manufacture and/or procurement of all army pyrotechnics. At that time there was very little information available on the manufacture of fireworks and productive capacity was very limited. Knowledge of the art had been handed down from generation to generation and was confined to a few skilled operators. In order to train new operators the Ordnance had to establish a special school. In the meantime research was conducted by the Trench Warfare Section of the Ordnance assisted by the Chemical Warfare Service and the American University Experimental Station of the Bureau of Mines. Various types of smoke signals were developed, which included rockets, rifle grenades, hand grenades, Very pistol cartridges, submarine recognition signals and smoke pots. In the spring of 1918 General Pershing directed that the French Army system of pyrotechnics be adopted by the AEF since the American forces were to operate with the French Army. Yellow smoke signals were the only ones which could be manufactured in the United States because all other colored smokes required dyes which were not produced in this country. As a result the only colored smoke munitions manufactured in the United States for signalling purposes during World War I were the Signal Parachute Rockets, M1, yellow smoke, the Very Parachute Cartridge, M1, yellow smoke, and the VB Parachute Cartridge, M1, yellow smoke, fired from a VB rifle discharger. By the end of the war the Allies had satisfactory smoke rifle grenades, Very Cartridges and rockets in a variety of colors. They had also used smoke for artillery spotting. Similar progress had been made by the Central Powers.

In 1920 the War Department assigned to the Chief of Ordnance the responsibility for all devices used by the Army for signalling or spotting purposes and having smoke producing components. While the Chemical Warfare Service manufactured some colored smoke pots for submarine recognition signals at the request of the Navy Department, no other work on colored smokes was done by the Chemical Warfare Service prior to the outbreak of World War II.

In October 1940 the Chief of Infantry stated that a requirement existed for a colored smoke marker for aerial delivery containers. The Ordnance Department and the Chemical Warfare Service (CWS) worked on this project on a cooperative basis. During the war the CWS rainbow series of colored smokes was developed for the sole purpose of signalling.

CWS Turns to Use of Organic Dyes

The Chemical Warfare Service found that the best way to produce a large volume of colored smoke was by the volatilization of organic dyes within a munition. The vaporized dye condensed on emission to form a colored smoke. During the development of these munitions the colored smoke mixture was pressed into M1 hand grenade bodies and sent to various agencies for testing. The Armored Force was particularly anxious to obtain colored grenades as a means of identifying tanks to friendly aircraft. General Patton heard about the development of these grenades and sent some officers to Edgewood Arsenal to observe the tests. These observers decided that the yellow smoke had the highest visibility and requested several thousand of these grenades be furnished immediately, so that General Patton's troops would be equipped with them when they landed in French Morocco. The grenades were actualy used in combat before they had been adopted as a standard munition. The Chemical Warfare Service continued development until the smoke in each of eight colors could be distinguished from an altitude of 10,000 feet. In May 1943 the grenades were put into full production in the following colors: yellow, red, green, orange, violet and black. Later the Army Ground Forces requested that a more rapidly burning grenade be developed. This grenade designated as Grenade, Smoke, M18, was standardized on 24 September 1943 and production was immediately commenced. By the end of November the grenades were being furnished the troops in red, green, yellow, and violet.

The number of colors had been reduced from eight to four to avoid confusion. Blue smoke was dropped because it offered poor visibility and was easily confused with violet, the black grenade because it was confused with battlefield fires or explosives, and the orange grenade was too similar to yellow to be distinctive. White grenades were retained for screening purposes but not for signal purposes. Army Ground Forces together with the CWS, the Air Force, the Navy, and the British representatives concurred in the selection of red, green, yellow, and violet as the standard colors. In addition to the colored smoke grenades, distress signals were prepared for the Air Force. The colored fillings were also used in many other munitions including rifle grenades, bombs, rockets, mortars and artillery shells. After several experimental models and field expedients were used, a standard sky marker, the Bomb, Smoke Colored Streamer M87 was standardized. This consisted of a train of eight grenades inserted into a tube for use as a visual signal by aircraft.

Importance to Paratroopers

Colored smokes are almost indispensable for the operations of paratroops. During World War II in the South West Pacific area the 503d Parachute Infantry Regiment requested that the 42d Chemical Laboratory Company develop a special type of small colored smoke candle for the use of parachute troops. Various expedients were tried. A smoke marker was developed by the Chemical Warfare Service in the United States for parachute delivery containers. It was ignited by a pull wire fuze attached to the left web of the parachute. It had a delayed ignition time of five minutes and a burning time of four minutes. The marker was furnished in red, yellow or green colors.

Colored smokes were invaluable as a means of identifying army ground troops to our own Air Force. They were also useful for our troops during the launching of an attack in all parts of the world. However, it was soon learned that the colors used had to be suitable for the local terrain. Certain backgrounds would make one color practically invisible while other colors would stand out clearly. For instance, green smoke could not be seen above a jungle background; yellow smoke was ideal for use in Tunisia but could not be effectively used in Sicily.

This created quite a problem because the grenades were usually shipped in a standard assortment of colors.

The effectiveness of smoke signals depended on its correct use. A good example of the proper use of smoke grenades was in the crossing of the Moselle River by the 5th Infantry Division. After the 10th Infantry Regiment had crossed the river it received close support of our strafing and bombing aircraft by indicating its position with colored smoke. The enemy counter-attack was broken up by our air support as close as 200 yards from our own lines.

Variety of Uses in World War II

Colored smokes were also used extensively to good effect in signalling between ground units as well as in air-ground coordination. During the fighting in the cities and towns of Europe, infantry-tank attacks were coordinated by the use of colored smoke grenades. The location of the several elements were determined by the command through a prearranged plan and color code. In this way the commander knew which places were cleared and which were still occupied by enemy troops. The artillery was also informed as to the location of friendly troops by the colored smoke signals. When smoke signals were used improperly the results sometimes proved disastrous. On several occasions in World War II the wrong signal was given by smoke and our troops called their own fire down on themselves. One example of this type of error occurred when the 410th Infantry, fighting at Uhrwilier, France, was bombed and strafed by our own aircraft. Shortly afterward its 2d Battalion received fire from their flanking 1st Battalion. An investigation found that a red smoke grenade had been erroneously set off behind our lines indicating an enemy target. To prevent such mistakes a theatre observer in North Africa had previously recommended that colored smoke be used either to designate a target "bomb there" or to mark friendly troops "don't bomb here," but that smoke should not be used for both purposes. He preferred the latter. On the other hand the First Army in Europe preferred that smoke be used to mark targets rather than friendly positions. They did not consider the use of smoke to indicate friendly lines satisfactory as it brought down hostile artillery and mortar fire on those points.

Confusion Fatal to Jap Force

A striking example of confused signals occurred in the battle of Milne Bay, New Guinea. The Australians and a few Americans were holding a position on the south side of a newly constructed air field against an advancing force of Japanese. Contact was made and the Japanese halted to build up their forces for the attack. The Australian signal for an alert at night was one red ball from a Very pistol. The signal for a defensive barrage was two red balls. During the night the Japnese massed for an all-out Banzai attack and were set for the charge when an Australian noticed a movement and fired one red ball to alert his comrades. The Japanese, hoping to confuse their enemies fired another red ball and launched the attack. The Allied gunners, spotting the two red balls, opened up with everything they had and the Banzai charge was made right into a defensive barrage. The attacking force was practically wiped out, and the victory went to the Australians.

The Japanese were very adept in the use of smoke for signalling purposes. They had a small self propelled candle that could shoot signal smokes above the trees. These were so effective that the United States developed a similar device, using the Japanese candle as a model. As the United States infantry preferred to use colored rifle grenades or shells from the 60-mm mortar for signalling, the American self propelled candle was never standardized. However, it is believed that the self propelled candle has unlimited possibilities and could be used in many forms for signalling, night illumination, and even for casualty effect.

In the earlier stages of World War II there was an acute shortage of colored smoke grenades. In fact, on New Georgia Island in August 1943, flame throwers had to be used as a substitute for marking positions because no colored smoke grenades were on hand. By the end of the war, however, production had passed demand and resulted in a great excess of several types of colored smoke grenades. This excess was accentuated by the fact, previously mentioned, that grenades had been issued in asorted colors while only certain colored smokes were satisfactory in a given location.

World War I and II revealed the value of colored smoke, especially for airborne units. In the course of their training after World War II both the 11th and 82d Airborne Divisions made repeated requests for additional allowances of colored smoke grenades for training purposes. A very large number of these grenades were used on each practice jump and the prescribed training allowance was completely inadequate. The appointment of General J. Lawton Collins as Chief of Staff of the Army brought increased emphasis on the proper use of colored smoke in combat, as he was keenly interested in the matter.

Colored smoke grenades have won themselves a permanent place among military munitions. Many lives have been saved and battles won in which the proper use of smoke grenades played an important role. It can safely be predicted that in any future war colored smoke will see even greater use than in the past.

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THE THREAT OF BIOLOGICAL WARFARE

By

DR. JOHN J. PHAIR, M.S.; M.D.; Dr. P. H.[1]

While viewing BW as a new threat to mankind, the author of this article, prepared especially for the Journal, emphasizes the importance of calm consideration of BW by the public. He sees need to improve and extend, but not to change, our existing health organizations and program in preparing ourselves to deal with this grim possibility.—ED.

Although endemic and epidemic disease has played an important role in all recorded wars or natural disasters, biological warfare (BW) or the deliberate dissemination of disease agents, introduces a new threat to mankind. Unfortunately, it has a dramatic aspect which has been distorted by fanciful stories of "germ warfare." The Federal Civil Defense Administration, therefore, is concerned with the education and orientation of the nation in regard to this weapon, neither minimizing nor exaggerating its effectiveness nor the value of available defensive measures.

Biological warfare is the intentional use of living organisms or their toxic products to cause death, disability or damage in man, animals, or plants; certain chemical compounds affecting plant growth are customarily included. The target is man, either by causing sickness or death, or indirectly through limitation of his food or agricultural crops by magnifying disease hazards. Man must constantly struggle to defend himself, his animals and his crops in competition with the insects and microorganisms of this world. The objective of BW is to nullify these defense efforts by distributing large numbers of parasites of native or foreign origin or their toxic products, taking advantage of the ability to utilize unusual methods of dissemination and abnormal portals of entry into the host target.

Man has yet to create a new organism but he can select or adapt mutations of native or foreign parasites and, with unusual means of dispersion, cause an extraordinary exposure, both in kind and intensity. Hundreds of articles, lay and scientific, have nominated various pathogens and methods. Among the human bacterial diseases are bacillary dysentery, cholera, undulant fever, tularemia, anthrax, plague, glanders, typhoid, the leptospiroses, treponematoses and salmonelloses. In the virus field are listed psittacosis, the several encephalitides, influenza, Rift Valley Fever, infectious hepatitis, dengue and smallpox. Rickettsial infections such as epidemic, endemic and scrub typhus, Rocky Mountain Spotted Fever and Q Fever have been named. Certain fungi have been included; namely, the etiological agents of coccidioidomycosis, histoplasmosis, nocardiosis, toxoplasmosis and blastomycosis. Protozoal infections such as malaria and amebic dysentery have been mentioned, and the toxins formed by B. Botulinus, C. Diphtheriae and various staphylococci, because of their extreme toxicity, have been brought forward for consideration.

Turning to domestic animals, there are many target populations, each with its individual entourage of parasites. Diseases not commonly found in this country are most often described as possible BW hazards. They include foot and mouth disease, rinderpest, Rift Valley Fever, Teschen disease of swine, hog cholera variants, fowl plague, and the highly fatal strains of Newcastle disease. The native infections such as anthrax, brucellosis, tuberculosis, hog cholera, vesicular exanthema, vesicular stomatitis, pullorum disease, fowl paralysis and the upper respiratory infections of chickens, pigs and cattle cannot be overlooked. Some can be as damaging as any exotic organism if permitted to run unchecked.

In the plant field are found even a greater number of possible target populations and biological agents. It seems likely that various viruses· fungi, certain bacteria, nematodes and many insect pests would be considered.

There are many methods easily adaptable for intentional dissemination. Bombs or spray generators can produce aerosol clouds of the biological material for limited targets or to blanket wide areas. Aircraft, balloons, submarines and surface vessels can launch similar attacks using many devices. Saboteurs can readily contaminate air, water, and food supplies.

DR. JOHN J. PHAIR

Dr. Phair, who holds both academic and graduate degrees from the University of Cincinnati and a Doctorate from the Johns Hopkins University, has a long background of experience as a university professor and as a consultant in the fields of bacteriology, preventive medicine and epidemiology. During the war period, he was Consultant to the Secretary of War serving as Director of the Commission on Meningococcal Meningitis under the Army Epidemiological Board. He is presently consultant to various agencies of the United States Public Health Service as well as to the Federal Civil Defense Administration. He is the co-author of several medical text books and has published a large number of scientific papers. Dr. Phair had a leading part in the preparation of new C.D. technical manual on Biological Warfare, on sale by the Government Printing Office.

(1) Professor of Preventive Medicine, College of Medicine, University of Cincinnati, Cincinnati, Ohio; Consultant on Biological Warfare and Communicable Disease, Federal Civil Defense Administration, Health and Special Weapons Office.

Animal diseases can be introduced and spread secretly through feeds, biologics, raw garbage, and even by infested wearing apparel. The utilization of wild animals cannot be overlooked. There are three avenues for use against plants and crops: (a) the destruction of plants during the growing season by chemical attack; (b) a mass inoculation with pathogenic spores; (c) the introduction—probably by covert means—of exotic pathogens or pests which would become serious disease or insect problems later.

Sensational statements have been bandied about concerning the effectiveness of this weapon and the defenses. Because history records and emphasizes the decimating effect of epidemics and pandemics during wars, it has been predicted that, in the event of a successful BW attack, entire populations would be disabled and many deaths could be expected. At the same time, it has been stated that the danger would be small, since man has survived centuries of natural exposure to infectious pathogens. Most of the predictions of the effect are controversial because the evidence required for any rational and logical prediction has not been assembled. In the light of present reports, a reasonable assessment of the peril places it somewhere between these two extremes.

Defense planning with these assumptions must accept that a determined enemy can and may attack man, animals or plants effectively by deliberately disseminating pathogenic agents, covertly or overtly, alone or in combination with other weapons systems. Although an attack might create an extremely serious situation, there is no need to believe that it would be catastrophic or that the resulting casualties would overwhelm our existing health facilities. Furthermore, the deficiencies in our knowledge of this weapon are not enough to prevent the development of an acceptable BW defense program. The understanding of the epidemiology and control methods for human animal and plant parasites which has been accumulated over many years by workers in the fields of preventive medicine, public health and agriculture would seem sufficient to permit a reasonable solution of the problem.

With the ability to pick and choose, it should be recognized that if BW attacks are mounted, a number of agents, either singly or in combinations, can be selected and spread by many avenues. Since the biological materials may cause reactions ranging from mild illness to death, the objective may be either to produce a large number of incapacitating illnesses or to strike terror by causing a large number of deaths. This freedom and flexibility prevents an accurate appraisal of the hazard and emphasizes the broad approach required for rational defense planning. To prepare for only a single agent or to consider that an enemy would not take advantage of the many openings, covert or overt, would be ridiculous. But it must be emphasized that until biological weapons have been used in an actual attack, all predictions, however sincere, remain in the realm of speculation.

The effectiveness of each agent and the relative efficiency of each method of dissemination are conjectural and the use of BW would have to be appraised on the basis of the estimated result, the risks involved and the cost as compared with more conventional weapons. The wide choice prevents any accurate appraisal of the threat and compels inclusion of every possible contingency in the defense plans.

The Defense Plan

Prior to an attack, emphasis is being placed on maintaing and increasing the resistance of target populations by improving those organizations and measures devised to protect the health and well-being of this country. Even though deficiencies exist, it should be recognized, but not complacently, that the United States is far better equipped in this regard than many other countries. There is no need to change Federal, State and local programs, but steps should be taken to bring about continuing, overall improvement in facilities, equipment, and procedures including the provision of trained personnel.

Detection

To meet a BW attack, it is desirable to know and quickly identify the agent employed. The routine analyses of water, milk and food represent the kind of measures needed and can be considered as a beginning in this area. Sampling of air is also a well established practice, particularly in industrial environments. Unfortunately, nearly all the procedures require hours, days or even weeks to complete. One of the most pressing needs in the BW defense field is more accurate and rapid means for determining the presence and identifying foreign material in air, water or foodstuffs. The capabilities of the present tests do not warrant any great hope for their application in the civil defense program in the immediate future. Even if the developmental investigations are successful, the field employment of such measures will have to be carefully studied in order not to overburden our facilities.

Until satisfactory instrumental methods for sampling the environment are developed, the occurrence of an unusual disease or of an epidemic will be the first indication that a BW attack has been sustained. Therefore, prompt reporting, followed by investigation of cases, presents for the near future the only achievable approach to the BW detection problem. To be effective, this defensive measure requires improvement in diagnostic procedures, both clinical and laboratory, reporting, and investigation and evaluation of disease outbreaks.

No new pattern is demanded. For man, physicians will rely upon the local health department for diagnostic assistance. The State health department should support the local efforts and should call upon the Regional Director of the Public Health Service. He, in turn, should seek aid from the Section Coordinator of the Sectional Research Program, the Communicable Disease and Environmental Health Centers of the Public Health Service, the Federal Civil Defense Administration, regional and national, and the Department of Defense.

Each area may vary somewhat in the formulation of operating procedures. The above is suggested as following the usual peace-time pattern for most situations. It should be recognized, however, that the channel as described is not necessarily the only one that can be used. If satisfactory liaison is established between the interested groups, many modifications are possible.

Absenteeism in the schools and industries often indicates the existence of natural epidemics and can be expected to serve equally well in the event of a BW attack. Hospital or clinic admissions, particularly of unusual diseases, also will help. The local health agencies must be certain that their personnel, the hospitals, the industries, the individual practitioners, and each citizen are alert to the possibility of BW and can furnish information to provide evidence that an attack has taken place.

For animals, the BW defense program involves cooperation of the Bureau of Animal Industry of the Department of Agriculture, State Livestock Sanitary Board and the Public Health Service of the Department of Health, Education and Welfare. Channels for diagnosis, reporting, and control are under their supervision. In

the plant field, knowledge of the biology and ecology of exotic diseases is being extended by the Department of Agriculture.

Countermeasures

A. Collective Passive Defense

(1) *Aerosols.* For the general population, unpressurized rooms and buildings will afford measurable shielding. Sealed buildings or other shelters, with ventilation systems where various filters can be used, furnish a more complete protection against a BW attack. However, their cost of construction and equipment, vulnerability to blast action, and dependence on electrical or other sources of power, render them impractical except in exceptional circumstances.

(2) *Direct Contamination.* Entrance of infectious enteric agents is usually effected through the ingestion of contaminated food, water and milk. These problems can be solved by utilizing the well known collective protective measures such as treatment of water supplies, pasteurization, etc.

B. *Personal Passive Defense.* The skin and mucosa of the respiratory and gastro-intestinal tracts are the principal portals of entry for many infectious agents. The masks, protective clothing and ointments for protection against chemical warfare agents provide adequate protection against BW agents but can be employed only if warning of an attack can be given and the devices donned prior to passage of the infective aerosol.

C. *Individual Defense*

(1) *Bio-prophylaxis*

(a) *Active Immunization.* Resistance against an infectious agent is best obtained through active immunization. Unfortunately, effective antigens have not been perfected for many of the BW agents. Obviously, this is a characteristic governing the choice of a parasite as a BW weapon. Likewise, immunity levels attained with the available antigens may not hold against the challenge of high dosage and unusual routes. Even if the technical problems now faced were quickly solved, immunization of the civil population still would present serious obstacles. The use of single antigens would not be logistically feasible. The development of polyvalent mixtures is being pursued, but these studies are embryonic and there is little hope that practical combinations, other than those now available in commercial channels, will be achieved in the immediate future.

For these reasons no campaigns for mass immunization are proposed. Attention has been given, however, to the need for expanding and improving the usual civilian immunizing programs. One approach is the promotion of a wider use of smallpox, tetanus and typhoid antigens among adults, particularly in industry. Since any program will be the responsibility of health departments, the operation of limited campaigns during peace will prepare them and the civil population for an emergency situation. Even if there were no threat of BW, maintenance of high immunity levels in the general population would be required to control disease during periods of forced evacuation or the destruction of normal safeguards.

(b) *Passive Immunization.* One defense measure is the use of antisera, antitoxins, immune sera, gamma globulin, etc. folowing a BW attack. Three major obstacles will be encountered. The unsolved technical problems in rapid detection and satisfactory identification constitute the first block. The second is that effective antisera have not been developed for many of the BW agents. Thirdly, a workable mass program is impossible to plan or conduct for the general population.

(2) *Drug Prophylaxis and Antibiotics.* The success of certain materials in the prevention and control of infectious disease suggests another method for meeting a BW attack. Unfortunately, many of the agents are not affected by readily procurable drugs, and it is more than likely that resistant strains would be selected. Such programs would encounter all the difficulties found in any mass approach, i. e., the need to detect and adequately identify a BW attack in time and place to permit recognition of the exposed group and to distribute the drugs. The danger of developing drug or antibiotic resistant strains and the problems of sensitization cannot be overlooked.

(3) *Therapy.* If it must be accepted that human cases probably will be the first sign of an attack and the chief reliance will be on prompt treatment, therapeutic materials must be assembled. At present, stockpiling of wide spectrum antibiotics appears to be the best approach. Many civil defense organizations have made such provisions.

D. *Disinfection (Decontamination)*

(1) *Collective Procedures.* Disinfection of the environment cannot be considered for large urban areas and civil populations. When an attack has been suspected, particularly during an overt operation, such procedures may be required for small enclosed spaces or structures vital to defense. In most situations reliance must be placed on time, drying, airing, simple washing and sunlight. If a persistent agent (spore former) is used, more drastic methods will have to be considered.

(2) *Individual.* As indicated earlier, the natural defenses of the human body will constitute a formidable barrier. If exposure occurs, the only additional procedure is the attempted removal of the agent from the skin and clothing by simple cleansing. Nothing can be done for materials inhaled or deposited on mucous membranes. Any recommendation must, of necessity, be general and fit into the usual patterns of human existence. At the moment, it does not seem desirable to go beyond the accepted rules of cleanliness and personal hygiene.

Summary

For the general population the defense centers upon the rapid recognition, reporting and treatment of cases. Until detection procedures are available, efforts can be directed only at minimizing rather than preventing casualties. These include shortening the period of incapacitation, reducing the number of deaths and preventing secondary spread. The position is taken that no new health problems will be created and reliance is placed in the existing health facilities of this country. Even though many glaring deficiencies exist, it should be recognized, but not complacently, that the United States is far better equipped to meet this threat than many other countries. For BW defense, there is no need to change the health programs but to take such steps as may be necessary to bring about continuing, overall improvement in personnel, facilities, equipment and procedures.

Successful operation of such a defense depends directly upon the availability and distribution of competent professional personnel. Since their duties are essentially those found in peace-time, no unusual training is required. Refresher courses may be needed in some of the accepted procedures, such as the diagnosis and treatment of various communicable diseases. All training programs must provide for multiplier courses designed to bring to all levels an understanding of the problem. Since the defense of the individual is a personal affair, the final goal is the proper orientation of the citizen to the danger and his responsibilities.

Member of Army Chemical Center's Chemical Corps Team fits gas mask on girl's face for proper size. Test was made, utilizing high school students, to determine sizes needed for prototype gas mask.

Pictured herwith are U.S. Army photographs showing an experimental type civilian protective mask developed at the Army Chemical Center, Maryland and referred to in the accompanying article. The currently available model is in five sizes and is of one piece construction incorporating a filter pad and eyepiece lenses.

GAS

A discussion of current civil defense thinking on the feasibility of gas attack on cities of this country and progress in protective measures including plans for provision of new types of gas masks developed by the Army Chemical Corps. This article entitled "Chemical Warfare and Civil Defense" was written for THE JOURNAL.

By DR. JAMES H. DEFANDORF*

Pharmacologist and Consultant
Health Services and Special Weapons Defense Office
Federal Civil Defense Administration

(EDITOR'S NOTE: *Description of the physiological action of nerve gas and methods of treatment is given in considerable detail in C. D. manual, "Health Services and Special Weapons Defense," published in 1950 and reprinted in 1952 and on sale by the Government Printing Office, price 60c. The manual states that atropine should be administered by a physician but the current thinking of C. D. health authorities is that immediate self-injection on known exposure is necessary.*)

Chemical attack in the form of nerve gases is generally conceded to be feasible against the critical target area populations of the United States. It is believed that in all-out enemy attack, nerve gases could be employed profitably in conjunction with atomic weapons.

The agents most likely to be used are the nerve and mustard gases. The respiratory system is particularly vulnerable to the action of the nerve gases, which by attacking the vital protective cholinesterase enzyme system of the body, are toxic in concentrations so small that they offer a real threat to the densely-populated areas of this country. Their vapors are absorbed through the respiratory tract and the eyes, and in the liquid form through the skin without producing local irritation.

The well-known persistent character of the mustard gases makes their large-scale employment also a possibility, particularly if an enemy is able to launch attacks from nearby points. The use of other agents, including the lung irritants, blood poisons, tear and sneeze gases, against the civilian population is considered improbable and in any event protection against them would be provided by gas masks which are essential for defense against the nerve and mustard gases.

*Dr. Defandorf has had extensive military service in the Sanitary Corps and Chemistry Corps of the Army. He was retired as Colonel AUS in April, 1952.

Gas to Compound A-Bomb Effects

It appears probable that escort bombers could lay down a high concentration of nerve gas in a band covering the outlying portions of the target, which might well compound the effects of atomic warfare on the more densely populated areas in the city, and cause many additional casualties.

In addition, the nerve gases might be used against selected individuals or groups in sabotage or subversive actions, and to contaminate ventilation systems or food and water supplies but these are situations which can only be handled through efficient local guarding and inspection procedures.

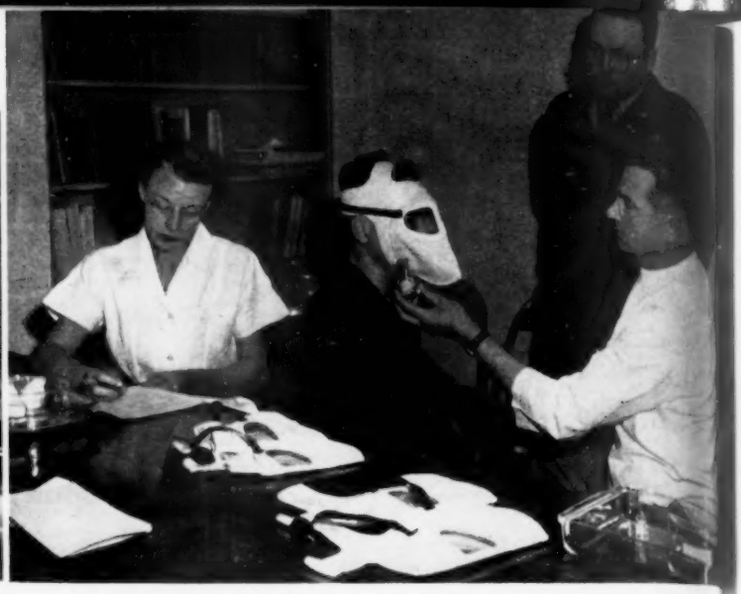
The gas mask presents the surest and least expensive method of protection against chemical warfare agents, and it is believed that the entire population of critical target areas should be equipped with some sort of protective mask. It is not felt necessary that protective masks be furnished for individuals living outside the critical target areas.

The Chemical Corps of the Army has been developing two types of masks which would be satisfactory for protecting civil defense workers and the civilian population. The first of these is almost ready for procurement, and it is planned to supply this item to the states under the Civil Defense contributions or matching-fund program. This mask will protect against inhalation of all known types of toxic matter chemical, biological, or radiological, and is comparable to the standard Army mask in this respect.

Lightweight Type Gas Masks

The other mask known as the lightweight mask is approaching the stage where completion of its develop-

Left: This picture shows the mask as it could be used by the engineer of a railroad train during a gas attack. Right: This photo shows the mask as it could be used by the driver of an auto during a gas attack.



Members of Army Chemical Center's Chemical Corps Team testing to check whether person wearing mask can detect an odor. Substance in vial is banana oil. Test was made, utilizing high school students, to determine sizes needed for prototype gas mask.

U. S. ARMY PHOTOS

ment is expected during the present fiscal year. This item is designed to afford protection for the duration of a single attack against the inhalation of all types of toxic agents, and is intended for use by citizens who do not have heavy civil defense duties to perform.

The main problem in relation to the lightweight mask is to determine how it will be made available to the citizens. It is not believed that Congress will appropriate funds in the amount that would allow this item to be supplied free to the citizen. It is expected to cost approximately $1.50 to $2.00, and every effort is being made to determine how this can be produced and sold, probably through normal trade outlets, to the individual.

It does not seem practicable to enter into a separate program of collective shelters for the civilian population as they are too expensive to consider under present conditions. It is agreed that it would be desirable for each family to have its own shelter, and our recommendation would be that in the event of an air raid warning each individual should don a mask and go to a shelter. He or she would then have protection against all airborne toxic agents.

Atropine Self-Injection Units

The other item of importance is the atropine self-injection unit following exposure to nerve gas and the appearance of symptoms. It is necessary that two milligrams of atropine sulphate be injected immediately. There are several devices for this purpose and FCDA is presently stockpiling these items. It is believed that two or three of these self-injection devices should be made available for sale to the individual citizen at the same time as the gas mask.

The gas mask and the atropine self-injection units are considered to be the most important parts of the program for defense against chemical attack. Of course, we are giving consideration to detection devices, protective clothing, decontamination, etc.; but the detection devices are not yet satisfactory or available for critical target areas.

A request has been made to the Chemical Corps to set up a course of training in defense against chemical attack for selected civil defense workers.

Request has also been made to the Department of Defense for declassification of certain training literature pertaining to defense against chemical and biological warfare, so as to make this information available to state and local civil defense personnel. It is also planned to abstract or reproduce other material which has been declassified and which would be of use to civil defense.

9-Point Gas Defense Program

From a civil defense standpoint, the following 9-point recapitulation or progress report is considered significant:

1. Commercial *fire and rescue (heavy duty) masks* have been tested by the Chemical Corps for protection afforded against war gases. Minor alterations which appear desirable have been brought to the attention of the manufacturers.
2. Final tests on the *duty or organizational gas mask* (for civil defense workers) are expected to be completed very soon, and it is expected that procurement negotations will be initiated shortly by FCDA.
3. It is expected that the final tests on the *light-weight mask for civilians* will be completed before the end of this fiscal year. A study is now being made to formulate policy on the use, procurement and distribution of this item.
4. *An infant protector* being developed by the Chemical Corps is expected to be completed during this Fiscal Year. Civil defense policy on and requirements for this item are under consideration.
5. *Atropine self-injection units* for treatment of nerve gas casualties are being procured under the stockpiling program. *Kits for the treatment of gas casualties* are proposed for inclusion in the stockpiling program. It is believed that they should be available in improvised and fixed hospitals.
6. FCDA is exploring the possibility of making available simultaneously to the individual by purchase the following items: civilian gas mask, atropine self-injection devices, protective ointment, and infant protectors.
7. To supplement information already published by the Civil Defense Administration a request by this Office to the Department of Defense has been made for *declassification in part or in whole of certain military manuals on CW and BW defense.*
8. FCDA has initiated a request to the Chemical Corps to provide a *training course in defense against chemical warfare* for selected civil defense personnel who could in turn provide training at the local level.
9. The *Hazards of stored chemicals* are being given consideration by FCDA and other Federal agencies concerned.

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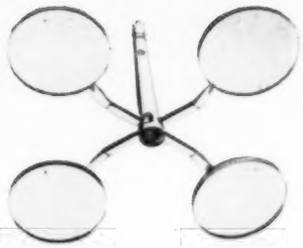

PLASTICS IN CHEMICAL WARFARE

By Cpl. Abe J. Goldsmith

The author of this article on the work of the plastics laboratory of the Chemical Corps Research & Engineering Command, Army Chemical Center, Md., is on duty there in the Technical Information Office. Cpl. Goldsmith is an alumnus of Purdue University with a B.S. degree. His assignment as Physical Science Research Assistant exemplifies the working of the Army's Scientific & Professional Personnel program under which the professional education of young college graduates inducted into the Army is being utilized by appropriate Technical Services.

Each day we find new evidences of the creation or enlargement of civilian markets through the development of products and processes by the armed services executing their missions in the National Defense.

The oldest of our nation's industries as well as those whose potentials have yet to be realized have been markedly affected by the research and development programs of the armed services.

One of the latest of these industries to be so affected is plastics, whose possibilities are beyond the imaginations of the most optimistic of its proponents. Plastics may be as hard and as tough as the finest steels or so soft and light as to protect the most fragile materials in transit. Plastics may be molded, extruded, formed, sealed, sewn or subjected to a combination of processes to produce an end-product.

Where does the Chemical Corps fit into the plastic industry? In October 1946 a project was established in the Chemical and Radiological laboratories, Army Chemical Center, Maryland, to investigate the uses of plastics. The project's specific mission was: to use commercially-available material and industrial processes and apply them to Chemical Corps items, to act as a clearing house for plastics information, and to develop new compounds and methods which will help the Corps to accomplish its assigned mission.

In the past several years the project has enlarged until it has become an integral part of the Chemical and Radiological Laboratory. In accomplishing its aims, the C&RL Plastic Laboratory has contributed to and has itself been helped by the plastic industry. The lab's work has saved the U. S. taxpayer during the past eighteen months alone an amount seven times the cost of its $65,000 physical plant. The time saved the defense effort by this laboratory cannot be evaluated or estimated in dollars and cents.

Adaptability is the key word to success in the field of plastic engineering. The processes by which plastic items are realized have been, for the most part, adapted from the metal, wood, and fiber industries. The newness of the field has resulted in few pure plastic processes, that is, processes developed for plastics solely and initially. Adaptability also means the selection of the type of plastic dependent upon the characteristics required to do the specific job.

A plastic is compounded much the same way as a baker mixes the ingredients for a cake. A recipe is formulated and followed so as to allow for the correct amount of the proper ingredients. This will insure that the end-product will have the desired characteristics. Basically plastics are composed of three types of substances: plasticizer, which determines the flexibility or rigidity of the plastic; filler, one or several substances which give body to the plastic and impart to it such characteristics as heat resistance or electrical conductivity (commonly used fillers include asbestos, mica, clay, linen, cotton and fiberglass) and finally a resin which serves as a binder for the other materials.

As a baker places his batter in an oven, so does the plastic maker, but his temperatures are much higher and vary much more than those of the baker. To each craftsman, however, his end-product must be ultimately fine and pure meeting standards of perfection as exacting in the one case as in the other.

It is impossible numerically to estimate the types of plastics. For example, one leading manufacturer has approximately 1900 classified compounds in its vinyl plastic series alone. Other widely used plastics such as styrene or methacrylate contain innumerable compounds under their simple headings.

The Chemical Corps' Plastic Laboratory's work has not been limited to Chemical Corps products as it has received many requests for work from the Navy, Air Force, and private industry. The Navy, for example, was experiencing a great deal of trouble with stores of bleach corroding their metal containers. The lab developed a

(Continued on Page 34)

Pictured on this page are various plastic munition or other parts made at the Plastics Laboratory.

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AGRICULTURAL RESEARCH I

By WALTER M. SCOTT*
Assistant Chief, Bureau of Agricultural and Industrial Chemistry
Agricultural Research Administration
U. S. Department of Agriculture
Washington, D. C.

Important contributions of agricultural chemistry in aid of our Armed Forces,—among them, form-fitting bandages, high-energy candy, ever-spread butter substitute, fire-resistant fabric and special lubricants are told about in this interesting article by Dr. Scott.—ED.

Dr. Scott is a member of the Washington Chapter of the Armed Forces Chemical Association. He was graduated from Yale in 1912 where he also received his Ph.D. in organic chemistry in 1915. After some 20 years in private industry, Dr. Scott went to the Southern Regional Research Laboratory of the Department of Agriculture in 1939 as head of the Cotton Chemical Processing Division. During the war years he served in the European Theatre of Operations as a colonel in the Chemical Warfare Service. In 1946 he returned to the Southern Laboratory as its director and in 1950 was promoted to his present position.

Dr. Scott is a charter member of the American Association of Textile Chemists and Colorists, and a member of the American Society for Testing Materials, the Textile Research Institute, the American Association for the Advancement of Science, the American Institute of Chemists, the American Chemical Society, the Southern Association of Science and Industry and Alpha Chi Sigma, chemical fraternity. He is the author of more than 40 technical papers and has been granted several patents.—Ed.

Introduction

The popular conception of an agricultural scientist is one who is capable of making two ears of corn grow where only one grew before. It is true that the research which makes it possible for our farmers to obtain higher yields per acre of the crops which furnish us with food, feed and fiber, is quite important to our National economy and is given strong emphasis in the U. S. Department of Agriculture. However, there are other areas in the field of agricultural research, the importance of which is recognized by the Secretary of Agriculture who has general supervision over this research and by the Congress which provides funds for its maintenance.

An idea of the wide variety of agricultural research that is being conducted in the various agencies can be obtained from the Department of Agriculture's Appropriation Act for the Fiscal Year of 1954, which was approved by the President on July 28, 1953. The Act provides funds specifically for the following lines of research:

1. To the Bureau of Plant Industry, Soils, and Agricultural Engineering for research on the production, harvesting, transportation and storage of farm crops; control of weeds and plant diseases; introduction of new and useful plants; improvement of soil productivity by the use of fertilizers and other soil additives; and the development of improved farm machinery and processing equipment.

2. To the Bureau of Agricultural and Industry Chemistry for research on the development of new and extended food, feed, and industrial uses for agricultural commodities, both plant and animal; and for potential replacement crops.

3. To the Bureau of Animal Industry for animal husbandry investigations; investigations of diseases of animals and remedies for the same; and improvement of poultry and poultry products.

4. To the Bureau of Dairy Industry for improvements in dairy cattle; and for research on milk and products derived from milk, such as butter and cheese.

5. To the Forest Service for research on wood and products derived therefrom, such as pulp, paper and chemical cellulose.

6. To the Bureau of Entomology and Plant Quarantine for investigations to determine the best means of protecting crops from damage by insects and related pests.

7. To the Bureau of Human Nutrition and Home Economics for investigations of the relative utility and economy of agricultural products for food, clothing and other uses in the home.

8. To the Production and Marketing Administration for investigations dealing with the standardization, classification, grading, handling, storage and marketing of agricultural commodities, food products and by-products.

9. To the Bureau of Agricultural Economics for economic investigations relative to agricultural production and distribution; utilization of farm and food products; and land utilization and conservation.

The purpose of this article is to describe the research in the Bureau of Agricultural and Industrial Chemistry on the processing and utilization of farm crops with particular attention given to those investigations which are of specific interest to our Armed Forces.

Function and Organization of the Bureau of Agricultural and Industrial Chemistry

The function of this Bureau is to develop new and extended outlets for agricultural products through research. The Bureau's activities are primarily designed to benefit the farmer by enabling him to obtain better and more stable prices for his crops. However, the developments resulting from the Bureau research provide industry and labor with new opportunities, and enable the consumer to obtain new and improved products and to pay lower prices for existing products because of reductions in the cost of processing.

This Bureau is one of the oldest agencies in the Department of Agriculture, for it is a direct descendant of the Bureau of Chemistry which was established in the year of 1862. Today its facilities include four large regional research laboratories — located in Philadelphia, Pa.; Peoria, Ill.; New Orleans, La.; and Albany, Calif.—and nine smaller field laboratories located in areas that produce the crops with which they are working.

*Served as Colonel in the U. S. Army during World II and was Chief of the Technical Division, CWS, ETOUSA, from 1942 to 1945.

I RELATION TO NATIONAL DEFENSE

The scope of the research activities of the Bureau is indicated by the following list of investigations on agricultural commodities and their derived products which are included in its research program:

I. *Cereal and Forage Crop Utilization Investigations*
   1. Corn, Wheat, Rice, and Other Cereal Crops
   2. Alfalfa and Other Forage Crops

II. *Cotton and Other Fiber Utilization Investigations*
   1. Cotton
   2. Wool

III. *Fruit and Vegetable Utilization Investigations*
   1. Citrus Fruits — Oranges, Lemons, Grapefruit, Etc.
   2. Deciduous Fruits — Apples, Peaches, Pears, Berries, Grapes, Etc.
   3. Vegetables—Potatoes, Tomatoes, Peas, Etc.
   4. Fermented Vegetables — Pickles

IV. *Oilseed Utilization Investigations*
   1. Southern Oilseeds — Cottonseed, Peanuts, Tung Nuts, etc.
   2. Northern Oilseeds — Soybeans, Safflower Seeds, etc.

V. *Sugar and Special Plants Utilization Investigations*
   1. Sugarcane and Sugar Beets
   2. Honey and Maple Products
   3. Tobacco
   4. Tanning Materials and Leather
   5. Pine Gum Chemicals — Turpentine and Rosin
   6. Special Plant Sources for Medicinals

VI. *Poultry, Dairy and Animal Products Utilization Investigations*
   1. Poultry Products — Eggs, Feathers and Poultry Meat
   2. Milk Products
   3. Animal Products — Particularly Animal Fats

VII. *Agricultural Residues Utilizations Investigations*
   1. Straw from Wheat, Oats, Rice, etc.
   2. Corncobs, Corn Husks and Corn Stalks
   3. Nut Shells and Fruit Pits
   4. Sugarcane Bagasse

VIII. *Other Investigations Related to Agricultural Products*
   1. Biologically Active Compounds
   2. Enzymological Investigations
   3. Immunochemical Investigations
   4. Pharmacological Investigations

In recent years, the Bureau has maintained close liaison with agencies in the Department of Defense. Many of the developments resulting from the research at the Bureau's Regional Research Laboratories are of direct interest to one or more branches of the Army, Navy and Air Force. A description of a few of the more important developments is given below.

Conforming Cotton Bandage

A new type of cotton bandage that conforms to body contours has been developed at the Southern Regional Research Laboratory. These semi-elastic all-cotton bandages have been adopted for procurement by the Department of Defense. The following quotation from a letter, dated 15 July 1952, which was sent by the Surgeon General of the Army to the Secretary of Agriculture, gives official expression of appreciation for this accomplishment:

> "The development of a simple chemical treatment of ordinary open-weave gauze bandage which shrinks the cotton yarns and produces a bandage with a high degree of crimp and kinkiness, giving it self-tightening and self-fitting characteristics which permits it to conform readily to body contours without restricting circulation or freedom of movement, is an outstanding contribution. These new bandages have been used in Army hospitals and under field conditions in Korea with great success."

The story behind this development is an interesting one and is typical of the difficulties that have to be overcome before a new product conceived by a research worker in the laboratory can be adapted for commercial production and made available to consumers in large quantities. The essentials of the process by which the conforming bandage is produced were conceived by its inventor, Mr. C. F. Goldthwait, about 15 years prior to his association with our Bureau. However, very little was done in the way of development until World War II when Mr. Goldthwait and his co-workers at the Bureau's Southern Laboratory cooperated with surgeons at the U. S. Naval Hospital in New Orleans to explore the possibilities of these conforming bandages. About 40,000 rolls of the improved bandage were prepared in the pilot plant at the laboratory and about 30,000 of these were used at the Naval Hospital. A joint report of these experiments stated that the bandage is unusually suitable for pressure dressings, including use for burns, varicosities and skin grafts, and is particularly good about joints where it is most desirable that the bandage should not slip.

U. S. Patent No. 2,379,574 was granted to Mr. Goldthwait on 3 July 1945 and assigned by him to the Secretary of Agriculture. The Naval Hospital recommended procurement of this bandage by the Armed Forces.

One of the Regional Laboratories of the Bureau of Agriculture and Industrial Chemistry, U. S. Department of Agriculture.

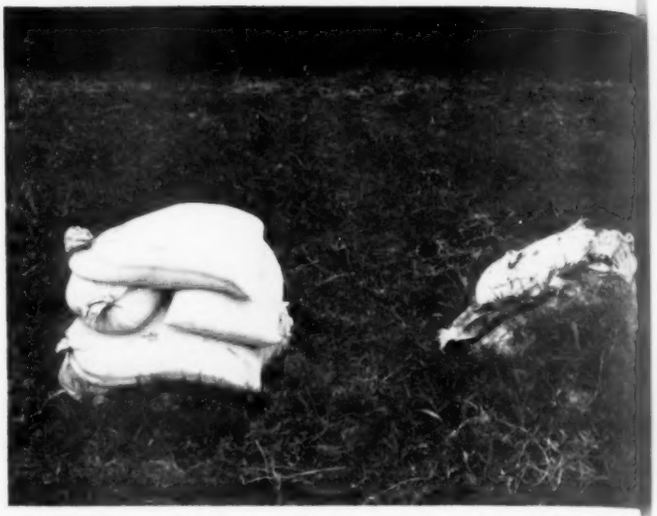
but the war ended before steps could be taken to implement this recommendation. During the period from 1946 to 1950, frequent attempts were made to interest the manufacturers of bandages in producing the conforming bandage for use by surgeons in civilian hospitals and elsewhere. These efforts were unsuccessful until the advent of the Korean war revived the interest of the Armed Forces in the unique properties of these bandages. The Research and Development Board in the Office of the Surgeon General of the Army obtained several thousand more bandages from our Southern Laboratory and demonstrated to their satisfaction that the conforming bandage was better than any other type not only for ordinary surgical use, but also in conjunction with a new compress and dressing developed for emergency treatment of burns. Specifications were prepared by the Armed Forces Medical Procurement Agency with the assistance of our Southern Laboratory staff and over 10 million of these bandages have been ordered up to the present time.

Cotton of Improved Heat- and Rot-Resistance

Cotton yarn and fabric that resists rot and mildew and is able to withstand higher temperatures than ordinary cotton is another development of the research staff at our Southern Laboratory. The treatment of cotton which gives it these added qualities is called "partial acetylation." In contrast to the previous story about the conforming bandage, this development which was stimulated during World War II by the interest of the Armed Forces, is now reaching the stage of large-scale commercial adoption because of its popularity for certain civilian uses.

Partial acetylation of cotton is not basically new—it was reported in England about 1900—but little information about the unique qualities of the acetylated cotton was available before 1942. In early tests at the Southern Laboratory strips of the treated fabric were buried in moist soil in New Orleans. They resisted rotting for many months although the untreated fabric lost practically all its strength after burial for only one week. This unusual resistance to deterioration by fungi (mildew) and other microorganisms caught the interest of the Army Corps of Engineers who were concerned with the procurement of sand bags for use in revetments, barricades, etc. Sandbags made of partially acetylated cotton were prepared in the pilot plant at the Southern Laboratory and stacked on damp ground in the humid climate prevailing at New Orleans. These bags remained in good conditions for over 2 years while bags treated with standard rotproofing chemicals such as copper naphthenate went to pieces in 2 to 5 months. However, before it could be determined how many sandbags would be needed for purposes where the longer life of the bags would justify the higher initial cost, the ending of World War II interrupted this phase of the development.

More recently, the improved resistance of partially acetylated cotton to deterioration by heat has aroused civilian interest in the use of this material for ironing board and laundry press covers where the cotton continually comes in contact with hot metallic surfaces. The advent of the new man-made fibers, such as nylon, which showed greater resistance to heat than ordinary cotton was causing cotton to be gradually replaced in this market which used about 50 million pounds of cotton in 1951. Trials conducted in commercial laundries showed that press covers made of nylon lasted 2 to 3 weeks longer than cotton press covers. The Southern Laboratory produced several hundred yards of partially acetylated cotton fabric in its pilot plant and this was made into press covers. The laundries found that the acetylated cotton press covers lasted longer than the nylon which had a higher initial cost. On the basis of these tests, several commercial cotton finishing concerns have started to produce acetylated cotton for press covers which are being sold not only to laundries through wholesale channels, but also to home users through mail-order organizations.



Cotton sandbags after exposure for one year in semi-tropical climate —treated bags at left and untreated at right.

Permanently Flameproofed Cotton

The flameproofing of cotton is essentially a safety measure for saving human lives, reducing injuries from burns and reducing losses of property from fires. Cotton and other cellulosic fibers, such as rayon and acetate, are naturally combustible and, unless treated in some manner, will continue to burn after being ignited by some source of fire.

Many types of treatments have been developed for flameproofing cotton and although some are quite satisfactory for certain purposes, they suffer from one or more defects. For example, impregnation of the cotton with such salts as ammonium phosphate or sodium borate (borax) will render it temporarily non-inflammable.

(Continued on Page 26)

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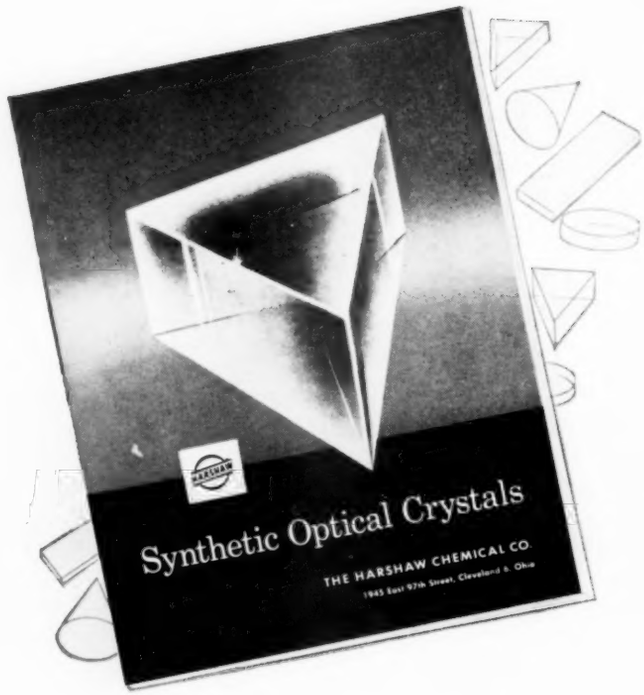

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SYNTHETIC OPTICAL CRYSTALS

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These salts, however, are readily soluble in water and are completely removed from a fabric when it is washed. Other treatments with chlorinated paraffin waxes or with metallic salts, such as sodium stannate or antimony chloride, provide a flame resistance that is retained after a number of washings but they give the cotton fabrics an objectionable appearance or feel which makes them unpopular for use in clothing or draperies.

In recent years, starting with World War II, the Armed Forces have become increasingly interested in the adequate protection against flame of the cotton fabrics which are widely used for clothing, tentage and tarpaulins in military service. The development by the Chemical Warfare Service of thickened gasoline (napalm) for use in long-range flamethrowers and incendiary bombs, intensified the need for furnishing military personnel with some form of flame-resistant clothing. The Quartermaster Corps which is concerned with the development of new types of clothing for all of the Armed Forces has established certain requirements for flameproofed fabrics. They must not continue to burn nor to show an afterglow when the source of the flame is removed, and these characteristics must be retained through a reasonable number of washings. Furthermore, they must provide protection against sudden bursts or concentration of heat (such as from splashes from fire bombs) by the formation of a strong carbonaceous residue. Finally, they must present a good appearance, be comfortable to wear, and not be allergic to the wearer.

Our Bureau has cooperated closely with the Quartermaster Corps in research to develop a treatment which would meet the requirements stated above and could be applied satisfactorily to cotton fabrics in commercial textile finishing plants. Several new treatments have been found to be promising and one in particular is arousing considerable interest in the textile industry at the present time. This process, which was developed by workers at our laboratory in New Orleans, involves the use of a phosphorus compound, known chemically as tetrakis (hydroxymethyl) phosphonium chloride and called THPC for short. Although this compound has been known to chemists for many years, the Southern Laboratory was the first to prepare it in sufficient quantities so that it could be applied to cotton fabrics on a pilot-plant scale. It was discovered that when an aqueous solution containing THPC, a resin monomer such as methylolmelamine, and urea was applied to the fabrics, and the impregnated fabric was dried, cured by heating, and washed, a high degree of flameproofness was imparted. The fabrics so treated retain their flame-resistance through a large number of washings. They have a pleasing appearance and have excellent wrinkle-resistance in addition to their flame-resistance.

One chemical manufacturer has already started the manufacture of THPC on a pilot-plant scale and other chemical firms have indicated interest. Several large textile finishing concerns have applied the treatment satisfactorily to sizeable yardages of fabric and plan to increase their production of flame-resistant cotton fabrics by this process when larger quantities of THPC become available.

The interest in flameproofed fabrics is not confined to the Armed Forces. The frequent occurrence of injuries (some of them fatal) due to the flammability of fabrics such as children's cloth chaps, chenille dressing gowns, sweaters, draperies and upholstery has greatly stimulated public interest in flame-resistant fabrics. Many State Legislatures have passed some form of flameproofing legislation and Congress approved a "Flammable Fabrics Act" in June, 1953. Therefore, it can be predicted that the civilian market for fabrics flameproofed by a treat-

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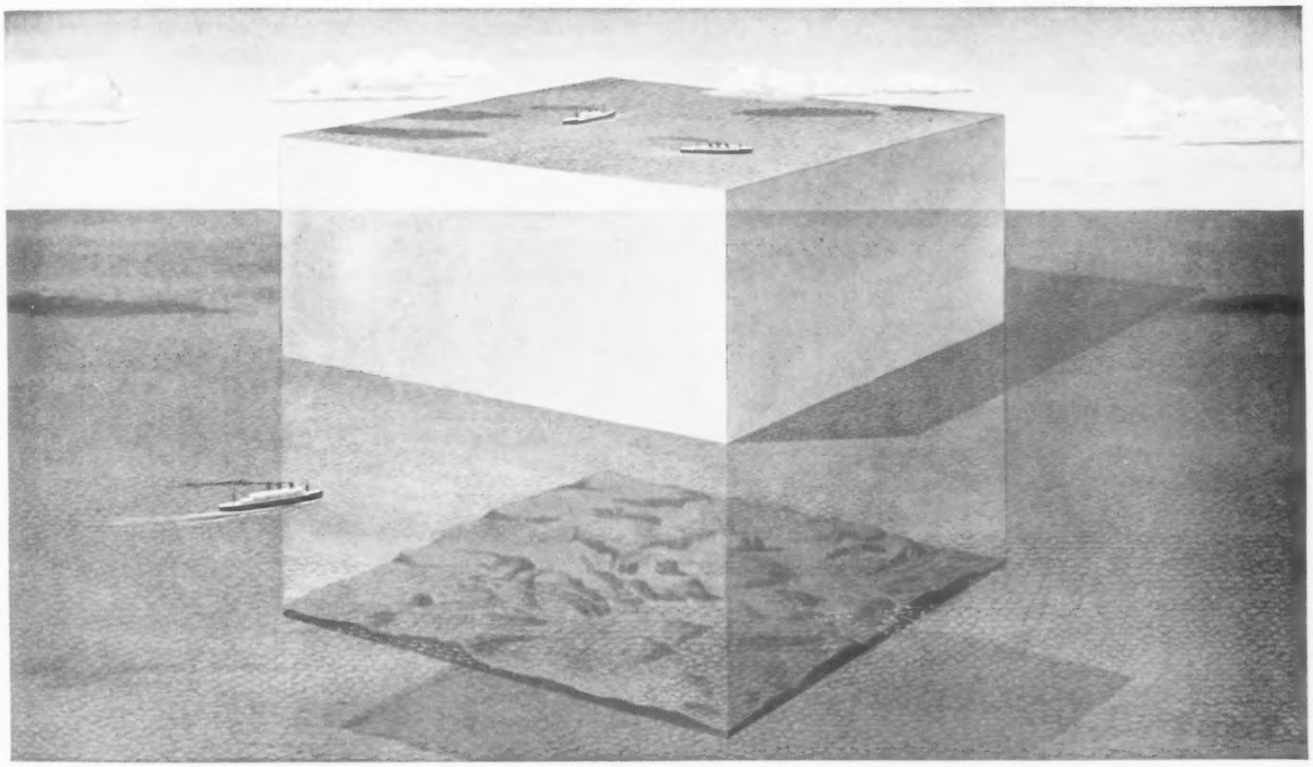
Each cubic mile of sea water contains six million tons of MAGNESIUM, the lightweight metal of so many uses



Today, when this nation is confronted with a crisis in our supply of many raw materials, it is of immense significance that the sea around us contains an almost unlimited supply of Magnesium. For Magnesium is light, strong, practical and versatile—excellent for use in military and civilian aircraft, and many other products.

Dow began research on the extraction of Magnesium from brine over forty years ago. In 1941, at Dow's Freeport, Texas Plant, *the first commercial extraction from sea water was begun*. Dow also pioneered in the production and development of Magnesium and its alloys and is still the leading producer and fabricator.

Magnesium is only one of more than 600 chemicals produced by Dow. From Dow's many rapidly expanding plants throughout the nation flows an increasing abundance of chemicals and chemical products used for both military and civilian production. Besides Magnesium, these include Industrial, Agricultural, and Fine Chemicals as well as Plastics. THE DOW CHEMICAL COMPANY, Midland, Michigan.

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DOW

ment similar to the one described above will be fully as large as the military market.

Dextran—A Blood Plasma Substitute

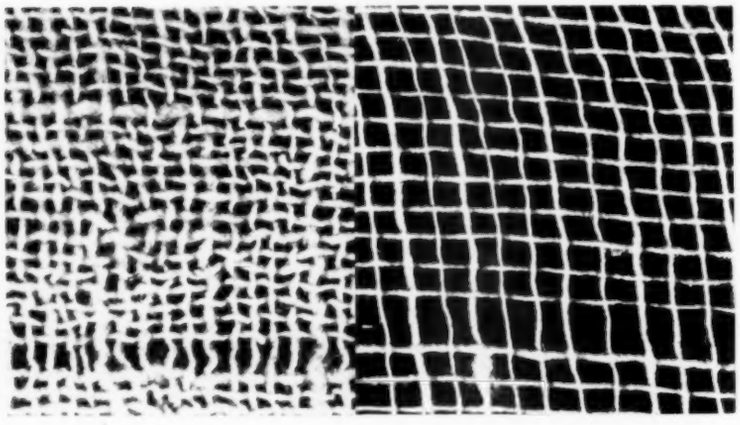
The need for a satisfactory substitute or extender for blood plasma has been recognized by the medical profession for some time and this need has been intensified since the outbreak of the Korean war. In addition to the increasing difficulty of obtaining adequate supplies of blood from which to separate and process the plasma for subsequent use, there have recently been many instances when infection has been transmitted from a donor of the blood to the recipient of the plasma.

The search for blood plasma substitutes covered a wide range of compounds from which a few were selected for larger scale clinical evaluation. Of these potential substitutes, dextran appears to offer the greatest promise at the present time. Many thousand units of dextran have already been administered in this country with successful clinical results and little evidence of specific tissue or organ impairment. The Army has conducted field trials of American clinical dextran in Korea, and in February 1953 the Surgeon General released dextran of specified quality for general Army use, wherever possible, in place of blood plasma. There are some clinical situations where oxygen carrying capacity is needed that can only be met by blood itself. However, dextran can be used for practically all of the routine treatments for injuries or during surgery.

Chemically, dextran is a generic name for a certain class of glucose polymers in which a majority of the glucose units are bonded together in a different manner than in starch or cellulose. The Northern Regional Research Laboratory of our Bureau played a role in the expansion of dextran production to a commercial-scale operation similar to the role which they played during World War II in commercializing the production of penicillin. It will be recollected that penicillin was discovered by Fleming in England several years before the war but only produced a few grams at a time by a long and tedious process of growing special molds. It remained for our Northern Laboratory to find in its culture collection an organism, which had been first obtained from a rotten canteloupe, that proved to be capable of expanding and producing penicillin in large quantities in commercial plants.

The Northern Laboratory in 1943 isolated from a bottle of decomposed root beer a strain of an organism identified by the code number NRRL B-512, which within the last few years has proven to be the best source for the commercial production of clinical dextran from sugar. Workers at the Northern Laboratory have developed a wealth of basic information on the preparation and the physical and chemical properties of dextran. This information has been of great value to commercial producers in the development of economical processes for producing dextran on a large scale and of test methods suitable for rigid control of the quality of the product. At the present time the organism NRRL B-512 has been adopted by all U. S. dextran producers as a standard strain for the production of clinical dextran for use as a blood plasma substitute or extender.

Cotton gauze, before and after treatment produce conforming bandage (magnified 15 times.)



Global Edible Spread

Butter and margarine are food products that are almost universally acceptable to citizens of the United States whether they are civilians or members of the Armed Forces. Little difficulty is encountered in the normal use of these products within the boundaries of this country where ample refrigeration is available for hot climates and indoor heating for cold climates. However, when artificial refrigeration is not available to our Armed Forces serving in other parts of the world, the reactions of these products to temperature variations present serious problems. For example, butter and margarine are stiff and very diffcult to spread at temperatures below 45° F., and at temperatures over 70° F. they tend to soften and become liquid.

The Quartermaster Food and Container Institute, which is concerned with the development of suitable types of food for consumption by the Armed Forces, has indicated their desire to obtain a spread for bread which will have the following characteristics: (1) a storage life

(Continued on Page 35)

a Dependable basic source of

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In 1900 a new frontier opened when our nation produced aluminum. Some thought aluminum could grow only at steel's expense. In the next half century, aluminum did grow, to eight hundred thousand tons. But steel went on regardless, in the same period—from eleven million to 105 million tons. And in the making of every additional ton of both steel and aluminum, additional tons of soda ash and caustic soda were consumed.

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One of today's insatiable, new markets for chemicals is plastics. With modesty—or maybe with reasonable pride—we say still more careers will open soon, more in the chemical industry than in any other. In DIAMOND's laboratories, the future is being charted along horizons yet only dreamed of, but just as promising as aluminum and plastics.

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Remarks by the Honorable John Slezak Before the Washington, D.C. Chapter, Armed Forces Chemical Association, 18 November 1953

NEW PROCUREMENT PLANS TO CONSERVE INDUSTRIAL TOOLS

—Photo by Earl Goldstein

Assistant Secretary of The Army John Slezak addressing the annual dinner gathering of the Washington Chapter, A.F.C.A., at the Cosmos Club, Washington, D.C., November 18, 1953. At the speaker's table, left to right: Mrs. Amos A. Fries, Maj. Gen. Amos A. Fries, Retired, former Chief of the Chemical Corps; Mrs. E. F. Bullene, Maj. Gen. E. F. Bullene, present Chief of the Chemical Corps; Secretary Slezak, Mr. Arthur M. Miller, Chapter President; Mrs. Arthur M. Miller; Col. L. W. Munchmeyer, National President of the A.F.C.A.; Mrs. Walter C. Baker, Maj. Gen. Walter C. Baker, Retired, former Chief of the Chemical Corps. In addition to the three general officers and a number of other military members the meeting included a good representation of the chemical industry to which Mr. Slezak's address was largely directed.

Gentlemen, it certainly is a pleasure to be here with you today. Your association is young, but we have already seen during the Korean crisis how effective you have made the industry-Army team in the field of chemistry. I have greatly admired all you have done to help the services and it was no surprise when Mr. Miller told me that you would want to know how you could do even more in the uncertain days ahead. I can think of no group I would rather turn to for advice and guidance on this unique part of our defense program. It really is comforting and reassuring when you take on a job like mine to know that there is a group such as this that is dedicated to serving the nation.

The work of your association has already had a profound effect on our defense effort. You may recall that there were many urgent design and production problems facing us during 1951 and '52. The military research facilities were already flooded with work. It was natural for the services to turn to industry in this crisis. The problems were turned over to the Chemical Corps Industry Advisory Committee, and the vast "know-how" of American industry was immediately focused on those difficulties. You all know the result. Whole families of weapons were affected. Flame throwers, smoke weapons and grenades were improved and many, many lives were saved.

You men represent a pool of production and management know-how that could not be formed within the Government at any price. As you well know, these talents can be gained and kept up to date only by intimate day-to-day contact with production problems. The most brilliant production engineer might soon lose much of his value if he were separated from the industry and brought into Government.

The Danger to Our Freedom

Yes, you provide a vehicle—a means through which many of our talented citizens can exercise their citizenship by using their talents for the good of our country. And that, my friends, is a very important contribution; because, I am not afraid that we will ever lose our freedom, our way of life to an outside aggressor, but I am afraid that we may lose it through default by not being active and participating citizens in our government—be it on local level, state level, or national level.

I remember another incident that is typical of this type of service and sacrifice. Back in 1950 it seemed that another world conflict might be forced on us. The future was most uncertain. For all we knew, all the deadly products of the laboratory might soon be used against us. The Chemical Corps sent out an urgent plea for scientists to help meet this threat. Of course this came just when the demands on industry were growing, and skilled scientists could least be spared. What followed was most heartening and encouraging. You looked over your undermanned staffs and gave up the men that were needed. Scores of scientists and highly-trained technicians flowed into government service and our defenses were greatly strengthened by your sacrifice.

In fact this incident illustrates the gravest problem that faces us today. It is the key to our whole defense planning. Let me explain. Traditionally we have always been a peace-loving people with no imperialistic designs or ambitions, so when we are making plans for the security of our nation they are always on a strictly defensive basis. However, I doubt very seriously that it is possible for us to be so armed as to be instantly ready to take on all comers without at the sametime sacrificing our standard of living and our way of life. Because of our traditional attitude, our strength must always lie in our ability in times of emergency to convert our economic resources into military strength quickly and effectively. Therefore, it becomes obvious that our greatest defense is not mountains of guns and shells—they decay and grow obsolete—but the ability of our people to create and to produce. And that ability rests entirely on our tremendous pool of management talent.

Let us look at the record for a moment. Appropriations for chemical materiel in 1939 were just over one-half

(Continued on Page 32)

Mr. Slezak has just recently been designated Under Secretary of the Army.—Ed.

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million dollars. In 1942, three years later, they were one billion, 067 million dollars—nearly a two thousandfold increase. Very much the same thing happened on a smaller scale upon the outbreak of war in Korea. Similar appropriations rose from about $23 million in 1950 to over $230 millions the next year. That is a 900% increase. Those are staggering changes in pace and no government could conceivably have in its services in peactime enough competent men to carry out such a tremendous assignment—and there is no time to train and to develop men after the emergency arrives. The only answer is to find an effective way of harnessing the technical and managerial talent developed by the American free enterprise system into this task quickly and effectively. You men here are doing tremendously constructive work in this direction but much, very much more needs to be done.

Army and the Insurance System

We in the Army are in a peculiar type of business. Essentially we are a division of your insurance system. How much and what kind of insurance is a difficult question to answer. Some get along without any insurance at all. Too much insurance on the other hand could wreck us economically and thus destroy our very way of life; because economic freedom is indivisible from personal freedom—you lose one and you lose them both.

Looking at it from my particular position, you have sent to Washington a group of dedicated men who are giving all they have in the service of our country. However, they can be only as good and only as effective as the support you are willing to give them.

We are very fortunate, indeed, to have the great industrial leader, C. E. Wilson, heading the Department of Defense. He has surrounded himself with some very outstanding aides and among them, in my opinion the greatest, is the Secretary of the Army, Bob Stevens. He has brought to the Army not only his great managerial talents but what is even more important, a selfless loyal dedication to our country. He is intensely loyal to the men and women that make up the Army organization. He is sincere, he is humble, he is understanding, he gets things done. To those of you who have known him for years this may be old stuff, but to me working with him has been one of the most satisfying experiences I have ever had.

Looking at it from inside of our organization set-up, I am tremendously impressed with how very difficult it is to get competent men to serve our country. Of course in most cases it does involve tremendous sacrifices. But, Gentlemen, we should and we must find ways to share these sacrifices so that we can induce some of our most competent men and women to serve our country in responsible jobs. Somehow we are willing to give of our money but not of ourselves—and yet the very foundation of our way of life is based on individual participation in our Government. No, my friends, we cannot hire George to practice our citizenship for us—not any more effectively than we can hire George to go to church and pray for us. Citizenship in our country is a very individual matter; we either practice it and retain our way of life or not practice it and loss our way of life by default.

I do not have to tell you that the men you have sent to Washington are very much economy conscious. They fully realize that government like an individual cannot forever spend more than it takes in. Obviously, the long-range results of such a policy would be disastrous and would jeopardize the very foundation of our way of life. However, it may take years of concentrated effort to undo the wasteful practices and habits that have prevailed for so long.

A free and easy spender is always more popular than a tightwad; and it will take much support from home to have the Government keep on retrenching and retrenching, when spending and spending, although ultimately disastrous, would be much more popular now.

There are many among you who are supplying the Army with various items of materiel. Some of you have written to me wondering what is going on. Are we again wrecking the Army by cutting the expenditures too far? To that I can give you an absolute and unqualified NO! On the contrary, we are maintaining and in some cases even improving our combat readiness. For too many years we have been deluded into thinking that merely spending large sums of money alone would buy for us defense readiness—nothing could be further from the truth.

New Expenditure Program

Let me explain very briefly just what is being done.

Until the advent of the new administration our entire defense readiness was based upon what may be called a static M-Day concept. In other words, the Joint Chiefs of Staff after studying the current world conditions developed an assumption on when and by whom we are likely to be attacked and evaluating all the factors involved they set the time for the probable M-Day, the type of military force, the size of it, and so forth, needed to meet the assumed situation. That being determined the material requirements were estimated and we proceeded to build up the necessary mobilization reserves. These reserves were determined on the standard requirement tables and also upon availability of each major item involved. For instance, if a particular item required a long lead time to get into production at a consumption rate necessary under the assumed conditions of war, adequate supplies would be purchased and laid in storage to provide for such conditions.

Under this policy, when let us say M-Day was arbitrarily set for 1 July 1953, we would proceed with full steam ahead to acquire the supplies required by this plan. However, if we did not go to war on that day and if we acquired the supplies required by such a plan we would stop all buying, disband the production capacity and wait in a stand-by condition for something to happen.

There were many weaknesses to this plan but the major one was that it was expensive and it did not give us the defense readiness that our type of economy and our way of life are capable of giving us.

The materiel procured started to become obsolete the moment it was delivered to us. Many of the items would deteriorate with age and become useless and of course the storage of these enormous amounts of materials was in itself very expensive. By disbanding our production organizations we lost a tremendous amount of mechanical and managerial know-how thus further lengthening the lead time requirement. Furthermore, we lost the daily intimate contacts with the men in industry upon whom we must depend for rapid conversion of our economic resources into military strength.

Now, under our present concept the basic assumptions remain unchanged. The Joint Chiefs of Staff still make their evaluation of the current situation and determine the size and type of military organization to cope with it. Material requirements are estimated the same as before except no definite M-Day is set. We work towards it but try not quite to reach it. In other words, instead of rushing toward meeting our mobilization reserve stock by a certain date and then going out of business, we try to keep the maximum number of organizations in production, and since this reduces the time required to reach full production required under the assumed war conditions we maintain our defense readiness with a much smaller amount of materiel on hand. Whenever we are approaching the set mobilization stock reserve for any given item we reduce the number of manufacturers

producing it and correspondingly increase the mobilization reserve requirement. In this way we are able to provide dynamic defense readiness and take fuller advantage of our industrial potential than the former static type plan made possible—and do it at much lower cost to the nation.

Of course there are other things that we are doing to improve our defense readiness and do it at lower cost to the nation. I have time to mention only a few of them.

Would Keep Facilities Intact

You all remember 1945-1946 when we not only wrecked our Army but also wrecked the industrial potential to re-create it in a reasonable time. With the end of hostilities, production lines were broken up and scattered. Tools were separated from their machines and machines themselves ended up in dozens of different factories all over the country. Industry bought the best and dealers wisely picked up much of what was left. With the exception of some single-purpose equipment, the Government was left with the dregs and the scrap. Very little or no effort was made to keep production lines and their tools intact. A joint Army-Navy board tried to salvage something from this wreckage but it was a discouraging job. Some of the events of those days seem unbelievable. I am sure you could tell many stories from your own observations, stories like the one about the chemical production equipment shipped to Pine Bluff Arsenal. Over one hundred carloads of improperly identified machines, tools and dies arrived there in one day. The Arsenal was instructed that not one dollar was to be spent for demurrage. You can guess what happened. It was stacked out in the open fields.

We do not intend to make those mistakes a second time. Our stand-by capacity can essentially be divided into three categories. Into the first category belong the cases in which entire factories for the production of some complicated long lead time items are held intact for production readiness. A good example of this group is the Niagara Falls Chemical Corps Plant which is now being laid away. The entire plant will be kept intact with machines in place—everything ready to run. Of course, this is not so ideal a situation as having a plant in operation, but it is the next best thing.

Sometimes we find that the entire plant cannot be put in moth balls. Then the machines and their tools are put in storage in the same plant or in a nearby warehouse. The essential thing here is that a "package" of tools is kept together. Everything in the way of machines and tools needed to go back into production is kept in the one place. That package is tied in with a given building, a given product and a given management. The Ford tank plant is an example. All the tools are being moved to a nearby warehouse and Ford will keep them in shape. There will be no question here of production being held up because of some critical long lead time machine or tool.

Another group of stand-by equipment is that put in central storage depots. The Chemical Corps has put all the production equipment from the Dryden Rubber Company gas mask line in such a depot where it can be stored and maintained. It will take a bit longer to get the line back in production, but central storage is much less costly. One of the big advantages of this arrangement is the fact that plant and product and management are tied together. The executives of Dryden know they will be expected to operate this line in another emergency and they can take it into consideration in their day-to-day management decisions.

An important part of this program is the setting up of a Production Equipment Records Unit at Rock Island. There, in one central place, a complete inventory will be kept of all ordnance machinery and tools and this may be extended to include all the production equipment controlled by the Army. The record will show the make and age and capacity and past use of every single item. This storing and record-keeping is costly, but it is good insurance. The machines and their tools will be ready if another emergency arises and we will know where to put our hands on what we want. Around 50,000 machines with their tools will come up for lay-away this fiscal year and we mean to take care of them.

Using Industry for Research

Some plants will be closed and many contracts will be stretched, but this does not necessarily mean that all branches of industry will be affected the same. The Chemical Corps probably will keep up or even increase its level of activity for the next three years. The program of incendiaries for the Air Force, for example, will not meet minimum stock requirements for some time and those production lines will be kept at better than minimum efficient rates until those requirements are met.

Aside from the normal type of procurement, the Army has been greatly impressed with the advantages of using industry to solve some of the Chemical Corps' design and research problems. An outstanding example of this type of work is the improvement of napalm, accomplished by industry on its own initiative. During World War II there were about as many types of napalm as there were firms producing it. The manufacturers got together and standardized, so we now have one product with only one set of characteristics. Not content with this, industry greatly improved napalm so that the area of burst was much greater. And finally, they made it cheaper. One of the essential agents was reduced in price from sixty-three cents a pound to seven cents. And this was industry' own idea. With such instances in mind, the Army is now exploring the possibility of turning over the entire research and development program for biological warfare to a civilian firm. We must be prepared to defend ourselves if an enemy ever introduces biological agents, and a research contract such as this might well mean the difference between success or failure. I think we can look forward to a steadily increasing use of industry's great research facilities in this manner.

Gentlemen . . . Our liberty and our way of life depend entirely on these links between industry and the military. I am proud to know men like yourselves who are working to make those bonds stronger . . .

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View of the shop of the Plastics Section, Chemical & Radiological Laboratories, Army Chemical Center, showing some of the types of equipment required.

Injection molder operator fills the hopper of the injection molder with granular thermoplastic material.

PLASTICS IN CHEMICAL WARFARE

(Continued from Page 20)

polyester fiberglass container which was lighter and which successfully resisted corrosion by bleaching agents.

A routine Air Force problem was also solved by plastics. The problem developed as the procurement of certain bombs was being hampered by a costly soldering operation involving a metal which would become critically short in supply during a full emergency. In place of the solder, a plastic adhesive resin was developed which exceeded all USAF specifications and, as a bonus, a pigment was added so that the painting operation of the entire assembly could be eliminated.

Why are plastics used? The most notable occasions have been mentioned previously, but there have been many others. However, plastic engineers are emphatic in saying that plastics are not used simply as substitutes; each time a plastic is used in place of another substance or material there must be a concrete justification. Many times substitution occurs in cases where a vital material becomes critical. This is sufficient justification, but the plastic people are aware that the critical material could probably do the job more efficiently.

American industry and the armed forces experienced this type of situation during World War II when rubber, itself a plastic, became critical as Japanese forces overran the latex producing areas of South East Asia. Butyl-rubber and other non-critical plastics had to be substituted. Certainly these standby products were not as good as natural rubber, but they served well in the crises. Now neoprene and other new compounds are available should this situation again arise. Moreover, peace-time uses have been found for b-Rubber and neoprene because of certain properties not possessed by natural rubber.

Another justification for the use of plastics is the factor of saving money, not the least important by any means. The Protective Division of the Chemical and Radiological Laboratories asked the Plastic Lab if it were possible to develop a plastic eyepiece for their standard issue protective mask. In this mask the glass eyepieces were easily broken and cost approximately one and a half dollars a pair in mass production. The Plastic Laboratory developed an optically acceptable unbreakable lens which, except for less scratch resistance, was equal to those of glass for a cost of approximately fifty cents a pair. An idea of savings afforded the taxpayer can be gotten when one estimates the number of masks necessary to equip the U. S. armed forces during mobilization. Based upon World War II strength, the savings would have been approximately ten million dollars.

The most common usage of plastics by the armed forces is to eliminate unnecessary weight and bulk while retaining the strength of the replaced material. Several months ago the Corps developed a new tactical field detector kit. This kit was designed to be carried by or parachuted to a soldier in combat. However, its weight made carrying by a lone soldier under combat conditions virtually impossible and if it were ever dropped from a plane it would have shattered upon reaching the ground.

The Plastic Lab tackled the problem and not only developed a plastic which would meet specifications, but also designed a new container. This redesigned kit made of polyester fiberglass allowed easier access of its contents, weighed seventy-five per cent less and was two-

(Continued on Page 40)

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AGRICULTURAL RESEARCH

(Continued from Page 28)

of at least 6 months at 100° F. without serious deterioration; (2) stability at freezing temperatures; (3) easily spread within a wide range of temperatures; and (4) comparable in acceptability to butter and margarine.

Our Northern Laboratory has developed a spread containing vegetable oils, monoglycerides, vitamins, flavoring and surface-active agents, which can be readily spread on bread at temperatures from 0° to 110° F. The first samples of this spread were submitted to the Food and Container Institute for evaluation over a year ago. Their taste panels reported that the initial samples showed promise but that considerable improvement needed to be made in their taste acceptance and storage stability. Recently new methods were discovered for treating the product to improve its storage life and its acceptability. Samples of the improved product are now being evaluated by the Food and Container Institute.

Our Southern Laboratory is attempting to solve the same problem by a somewhat different approach. They have prepared a margarine-like product from hydrogenated (hardened) cottonseed oil and aceto-olein. The latter compound is a tailor-made fat product which is produced by reacting glyceryl mono-oleins with acetic acid. The spread contains over 75% of the aceto-olein product, about 18% of highly hydrogenated cottonseed oil, and small amounts of salt, butter flavoring and butter color. It maintains its consistency and can be spread at temperatures ranging from 5° F. to 120° F. It resembles ordinary margarine in appearance and taste but is much less susceptible to spoilage during storage. Preliminary tests give every evidence that the product is completely edible, but physiological tests are continuing until there is clear proof of edibility.

Edible Plastic Coatings

A companion development of the aceto-olein used in the global spread described above has been investigated by our Southern Laboratory during the past year. This is the chemical combination of acetic acid with monoglycerides in a mixture of mono-, di-, and triglycerides derived from ordinary hard fats to produce solid products that are both non-greasy and plastic. These products, which are known to the chemical industry as acetostearins, are capable of forming films which have edible characteristics similar to aceto-olein. They are being considered for use as coatings for a great variety of food products, such as frankfurters, cheeses, fruits, and nuts. Steps are being taken to demonstrate their edibility by physiological tests.

Improved Candies for Army Rations

The Quartermaster Food and Container Institute has recognized that some forms of candy have many advantages for use as rations for the Armed Forces under certain circumstances. Candies are more stable than many others forms of food products and provide a very convenient source of energy in a highly concentrated form. This is particularly important in the so-called "survival rations" which are provided for members of the Navy and the Air Force who might be set adrift on the ocean or lost in isolated regions on the land. Past experience has shown that specially fortified food items prepared solely from the standpoint of stability and concentration of vitamins and other nutritional factors were eaten with great difficulty by military men because of poor acceptability.

The Southern Laboratory of our Bureau, which is concerned with the utilization of sugar and any products made therefrom, has cooperated closely with the Quarter-

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master Food and Container Institute and the National Confectioners' Association in the development of new types of candies. In their candy laboratory, there has been installed small-scale equipment which is ideally suited to the trial of radically new ingredients or modifiers, and of major alterations in candymaking procedures. The 5 to 10 lb. batches produced in this laboratory provide sufficient candy for preliminary evaluation in storage tests and for the selection by taste panels of the more promising items for exhaustive study and eventual field testing.

The following items have been prepared for evaluation at the Quartermaster Food and Container Institute:

1. Chocolate-coated disc-type bars containing a variety of fondant, fudge and cream-type centers enriched by added proteins.

2. Spun peanut-butter candy bars with added yeast and containing a preservative to avoid loss of flavor during storage.

3. A highly acceptable honey nougat bar with added humectants and stabilizers to provide the desired storage life.

4. An imitation butter-cream bar in a variety of flavors.

Current research is being directed toward the development of an improved starch jelly containing fruit, and a new four-piece butter cream bar.

Synthetic Lubricants from Turpentine

Pine gum is one of the agricultural products included in the research program of our Bureau. The long-established uses for its components—turpentine and rosin—have been threatened in recent years by the competition of synthetic solvents and thinners in the paint industry, and other synthetic substitutes in the naval stores industry. Our Field Laboratory located at Olustee, Florida, has been studying the chemical composition of turpentine and rosin with a view to converting them by chemical means into other products with greatly expanded uses.

One of the components of turpentine is alpha-pinene. This can be converted into a dibasic acid, called pinic acid, whose esters appear to be especially adapted for use in certain types of lubricants. The research group at Olustee have prepared a large number of these esters for evaluation by the Navy. Lubricating oil compositions have been developed which establish the suitability of the dialkyl pinates for use in oils for various purposes and over a wide range of temperatures. Excellent pinate-base greases have also been prepared in combination with soaps and other gelling agents. It is estimated that at least 100 million pounds of alpha-pinene could be produced annually from turpentine sources. This would increase our country's strategic reserve of raw materials suitable for the production of special lubricating oils and greases.

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Conclusion

The dependence of the Armed Forces, as well as our civilian population, upon agricultural products for their requirements of food, clothing and shelter, as well as of special chemicals and medicinals, has been illustrated by the examples cited above. It has been shown that research on agricultural commodities is not limited to the development of new varieties of plants or new species of animals. The specific examples used in this article were selected with a view to emphasizing the broad character of the research devoted to better utilization of agricultural products.

Research in the field of cotton textiles resulted in the development of (1) a new type of cotton bandage that conforms to body contours and is especially adapted for use in conjunction with a new compress and dressing developed for emergency treatment of military personnel with thermal burns; (2) a chemically modified cotton fabric that has unusual resistance to deterioration when used for sand bags; and (3) a flameproofed cotton fabric that is comfortable to wear and retains its flame resistance through many washing cycles.

Research in the field of food resulted in the development of (1) a substitute for butter and margarine that can be used equally well by our Armed Forces in the heat of the tropics or the cold of the Arctic regions; (2) edible films suitable for coating and preserving a great variety of food products; and (3) improved candies with high nutritional value that can be used for emergency Army rations.

Research in the field of fermentation of agricultural products for medicinal use resulted in the development of (1) a satisfactory process for producing penicillin commercially on a large scale; and (2) the discovery of an organism that is capable of large-scale production of clinical dextran suitable for use as a blood plasma substitute or extender.

Research in the field of chemicals obtained from pine gum resulted in the development of pinic-acid esters that are suitable for use in lubricants required by the Army, Navy, and Air Forces.

The magic whispers...

When Grandpa tucked you between his knees, you knew you were going to listen again to his wonderful watch—to hear its magic tick . . . tick . . . tick . . .

And as you listened, those measured whispers of time shut away the world, leaving you close to Grandpa, secure in his love.

From fathers and mothers to sons and daughters passes the lifeblood of happiness—security. The privilege of providing it for those we love can be found only in a land like ours.

And another wonderful thing is this: By realizing this privilege of freedom for ourselves, we achieve the security of our country. For, think—the strength of America is simply the strength of one secure home touching that of another.

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CHEMICAL CORPS BRIEFS

DUGWAY SOFT BALL TEAM

Surrounded by members of the Dugway Proving Ground, (Utah) softball team, who represented the Inter-Mountain area in the Sixth Army finals at San Francisco, Colonel Donald H. Hale, Post Commander, (center) displays the cup presented to the team for winning runner-up position in their Salt Lake City league. Left to right bottom row: Allen N. Netburn, Leon Hamilton, Calvin M. Giagrossi, Merrill L. Elwell; Second row, Capt. Sidney D. Gerstenhaber, Coach Colonel Hale, Capt. Hal R. Montague, Capt. Roberto Peralto; Third row, John Kirby, Jack E. Denman, Joe Bass, Darrell E. Loeh, Fourth row, Theodore C. Wright, Bernard F. Rose, James E. Scrivner and Robert A. Sauerberg.

* * *

Left to right: General Black, Colonel Cummings, Colonel Johnson, Colonel Buckley.

THREE COLONELS RETIRED

Three Chemical Corps Reserve colonels in the New York area were transferred recently to the Retired Reserve. They were Col. Samuel N. Cummings, senior Chemical Reserve officer in the First Army Area and Commanding Officer of Mobilization Detachment No. 10; Lt. Col. Frank R. Johnson, Deputy Commander of the Research & Development Group and member of the 301st Logistical Command, and Lt. Col. Jack E. Buckley, 1996th Research and Development Group. Each of these officers had a long association with the Chemical Corps, Colonels Cummings and Johnson having served in that branch as privates in World War I.

In honor of this occasion, a dinner was held on Oct. 1, last by the New York Chemical Reservists at the famous 7th Regiment, National Guard, Armory. More than one hundred Chemical Corps Officers and civilians from the New York Chemical Procurement district attended. Brig. Gen. Henry M. Black, Commanding General, Chemical Corps Materiel Command, the principal speaker, paid tribute to the services rendered by the three retiring officers. Other speakers were Major General William N. Porter (ret.), wartime Chief of the Chemical Corps; Colonel Harry A. Kuhn, (ret.), one-time Commanding Officer of the New York District; Colonel Walter A. Guild, Chemical Officer, First Army; Colonel Theodore Marshall, C.O., 1996th Research & Development Group; Col. Joseph F. Escude, present C.O., New York Chemical Procurement District, and Colonel Almon Bowes, present C.O., Detachment No. 10, who also served as toastmaster.

Col. Harold F. Cooney, Chief of the New York Military District, presented First Army and District citations to the three retiring Chemical Corps Officers as well as to Col. Emanuel Krinsky, a Medical Officer attached to the Research Group, who had accomplished extensive research in the field of Chemical Warfare.

* * *

MR. SAUL HORMATS

MR. LOUIS BENJAMIN

SCIENTISTS HONORED

Certificates of Achievement were presented recently at Army Chemical Center, Md., by Brig. General William M. Creasy, Commanding General, to two employees: Louis Benjamin and Saul Hormats of the Chemical and Radiological Laboratories. Mr. Benjamin has held the position of Chief of the Test Division since it was organized in 1945. The certificate was in recognition especially of his work in developing and improving test methods and techniques.

Mr. Hormats, Chief of the Protective Division, holds one of the most important and difficult positions at C& RL. He is recognized as an authority in the field of absorption and charcoals and is well known in the United States and other countries as an expert in the field of Protection.

* * *

COLONEL MILLER TO DETRICK

Lt. Colonel Cecil D. Miller, Chemical Corps of Martinsburg, W.Va., recently assumed command of Camp Detrick, Md. He succeeds Lt. Col. John W. Fitzpatrick who has just retired. Col. Miller who is no stranger to Detrick personnel returned from Fort Terry, N.Y. where he served as Executive Officer.

CHEMICAL CORPS KEY PERSONNEL

OFFICE OF THE CHIEF CHEMICAL OFFICER
Chief Chemical Officer—Major General Egbert F. Bullene
Deputy Chief Chemical Officer—Brigadier General Charles E. Loucks
Executive Officer, OCCm10—Colonel DeLancey R. King
Chief, Administration Division—Colonel Norman D. Gillet
Chief, Plans, Training and Intelligence Division—Colonel Ralph B. Strader
Chief, Research and Development Division—
Chief, Materiel Division—Colonel Joseph F. Escude
Comptroller of the Chemical Corps—Colonel James H. Batte
Legal Advisor—Lt. Colonel Herbert K. Greer
Chief, Program Coordinating Office — Colonel William H. Greene
Chief, BW Liaison Office—Lt. Colonel Rhett G. Harris

ASSISTANT TO THE CHIEF CHEMICAL OFFICER FOR BIOLOGICAL WARFARE—Colonel John J. Hayes

ARMY CHEMICAL CENTER, MARYLAND
HEADQUARTERS
Commanding General—Brigadier General William M. Creasy
Vice Commander—Colonel Frederick W. Gerhard
Deputy Post Commander—Colonel Walter L. MacLachlan

FIELD OFFICE, CHIEF CHEMICAL OFFICER
OFFICE OF THE INSPECTOR GENERAL
CmlC Inspector General—Colonel Russell W. Dodds
OFFICE OF THE SENIOR SCIENTIFIC ADVISOR
Assistant to Senior Scientific Advisor—Lt. Colonel John A. Bacon Jr.

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Deputy Commander—Colonel Claude J. Merrill
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Commanding Officer—Major John Moran
Eastern Chemical Depot
Commanding Officer—Colonel John P. Youngman
Inspection Equipment Agency
Commanding Officer—Captain John Marrero
Technical Escort Detachment
Commanding Officer—Colonel Garland M. White
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Atlanta Chemical Procurement District, Atlanta, Georgia
Commanding Officer—Major John H. Eller
Boston Chemical Procurement District, Boston, Massachusetts
Commanding Officer—Colonel Dominic J. Chiminiello
Rocky Mountain Arsenal Procurement Office, Chicago, Illinois
Commanding Officer—Colonel Donald G. Grothaus
Pine Bluff Arsenal Procurement Office, Dallas, Texas
Commanding Officer—Lt. Colonel Edward N. Fitzgerald
New York Chemical Procurement District, New York, New York
Commanding Officer—Colonel Harold Walmsley
San Francisco Chemical Procurement District, Oakland, California
Commanding Officer—Lt. Colonel William A. Johnson Jr.
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Commanding Officer—Colonel John D. Tolman
Midwest Chemical Depot
Asst. for Depot Operations—
Memphis General Depot, Memphis, Tennessee
Section Chief—Lt. Colonel Carl E. Grant
New Cumberland General Depot, New Cumberland, Pennsylvania
Section Chief—Major Alva G. Bearden
Utah General Depot, Ogden, Utah
Section Chief—Captain Fred S. Weston
ARSENALS
Pine Bluff Arsenal, Arsenal, Arkansas
Commanding Officer—Colonel Robert W. Breaks
Rocky Mountain Arsenal, Denver 2, Colorado
Commanding Officer—Colonel Adam W. Meetze

CHEMICAL CORPS RESEARCH AND ENGINEERING COMMAND
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Deputy Commander—Colonel William E. R. Sullivan
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Chemical Corps Medical Laboratories
Commanding Officer—Colonel Norman W. Elton
Chemical Corps Engineering Agency
Commanding Officer—Colonel Willis R. Givens
Chemical Corps Research Procurement Agency
Commanding Officer—Lt. Colonel David D. Hulsey
OTHER INSTALLATIONS
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Commanding Officer—Lt. Colonel Cecil D. Miller
Dugway Proving Ground, Dugway, Utah
Commanding Officer—Colonel Donald H. Hale
Fort Terry, New York
Commanding Officer—Lt. Colonel Don L. Mace

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SECOND ARMY, FORT GEORGE G. MEADE, MARYLAND —Colonel Raymond T. Beurket
THIRD ARMY, FORT McPHERSON, GEORGIA — Colonel Carl V. Burke
FOURTH ARMY, FORT SAM HOUSTON, TEXAS—Colonel Richard R. Danek
FIFTH ARMY, CHICAGO, ILLINOIS—Colonel Stoessel S. Barksdale
SIXTH ARMY, PRESIDO OF SAN FRANCISCO, CALIFORNIA—Colonel Roy W. Muth
SEVENTH ARMY, EUCOM—Colonel Ronald L. Martin
EIGHTH ARMY, FECOM—Colonel David Armitage
MILITARY DISTRICT OF WASHINGTON—Major Arthur M. Frey

(NOTE: If no officer listed, a vacancy is pending.)

THE HISTORICAL CORNER

By BROOKS E. KLEBER*

CAPTAIN W. LEE LEWIS AND THE "DEW OF DEATH."

Lewisite — once graphically known as the "Dew of Death"—has been called America's main contribution to the *materia chemica* during the first World War. While lewisite has had its share of publicity in the past thirty years, its inventor, Captain W. Lee Lewis, CWS, has remained in comparative obscurity.

Captain Lewis headed the project at the Research Division, American University Experiment Station, that developed the gas which bears his name. Originally, Lewis was an Engineer officer but with the establishment of the Chemical Warfare Service, he transferred to that branch. He continued his service in the Reserve and attained the rank of colonel. His academic background included degrees from Stanford, the University of Washington and the University of Chicago (Ph.D). Upon leaving the service in 1918 he became head of the chemistry department at Northwestern University. In 1924 Lewis was appointed Director of the Department of Scientific Research of the Institute of American Meat Packers, a position he held until his death in 1943.

From the time of its invention in 1917 until the mid 1940's, lewisite was considered an outstanding war gas, although it had never been used in combat. It was first produced late in World War I, but the Armistice came just as it was prepared for shipment to France. Studies made during World War II revealed that it was far less potent than had been thought, and by 1945 it had been virtually abandoned as a standard chemical warfare agent.

Captain Lewis died a year before these final studies and thus was spared the knowledge that his discovery, lewisite, was not the "Dew of Death."

*Member of the Staff, Historical Office, office of the Chief Chemical Officer.

PLASTICS IN CHEMICAL WARFARE

(Continued from Page 34)

thirds the size of the original. It could be carried easily and comfortably by one man and should withstand all parachute drop tests successfully.

Although the potential usages of plastics are infinite, the researcher usually only considers plastics from sheer desperation as other materials prove inadequate for a job. Many capable engineers are unaware of the potentialities of plastics because it has been only in the past several years that universities have added plastic engineering to their curricula. Engineers who are unaware of the possibilities of plastics will approach the plastic lab with their seemingly insurmountable problem. The Chemical Corps' Plastic Lab has very often found itself a court of last resort for the armed forces and industry, and more often than not, plastics can do the job.

Recently the Chemical and Radiological Laboratory was in need of specimen slides for use in electron microscopes. The Plastic Lab selected the proper plastic and designed a mold which was fabricated in the C&RL machine shops. It was determined that all desired shapes of slides could be made from the same basic mold by varying inserts. The entire project was completed in a matter of days whereas if the task had to be taken to outside firms, delays would have been numerous while contracts were being let, research undertaken, and production of limited quantities begun. In such an item as this where there is a limited production, it is advantageous to all concerned for the job to be accomplished locally.

This, however, is an isolated case. The Chemical Corps' Plastic Laboratory is not in existence to compete with industry. Though the lab can duplicate any industrial productive process, it cannot, nor does it seek, to duplicate private industry's productive capacity. Its work is limited to research and development projects and limited production of high priority items.

Practically all research and development items are carried through the prototype stage in the Army Chemical Center Laboratory. After the prototype has been tested and proven commercially feasible, bids are asked for full production. All the knowledge gained by plastic lab personnel goes with the contract. If the manufacturer encounters difficulties, the problems are usually solved jointly. In this way the contractor may begin immediately to mass produce the desired items. He can be reasonably certain that, after allowing for certain shortcuts which his industrial engineers will devise, the Chemical Corps' Plastic Laboratory has developed the best method to produce the finest end product for the National Defense.

MRS. PLANT RETIRES

Mrs. Ethyl G. Plant's 32½ years of Government service came to a formal close at a retirement ceremony recently held in her honor in the Office of the Chief Chemical Officer, Major General E. F. Bullene. A certificate was presented Mrs. Plant in appreciation of her 21 years of continuous service with the Chemical Corps and she also received a gift from her fellow-employees together with a scroll bearing their signatures.

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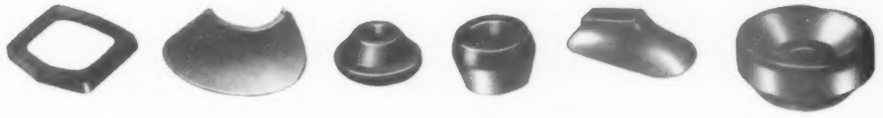
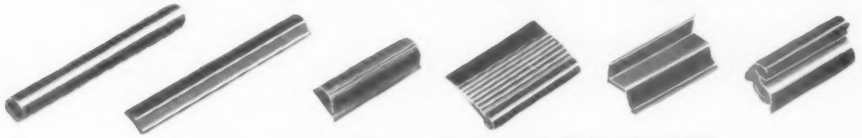
EXTRUDED
SHEETS



ACCURATELY MOLDED RUBBER PARTS



EXTRUDED RUBBER AND PLASTIC PARTS

LATHE CUT RUBBER

DIE CUT RUBBER

PLASTIC SHEETS

SILENTBLOC MOUNTINGS, BUSHINGS, BEARINGS

METAL STAMPINGS

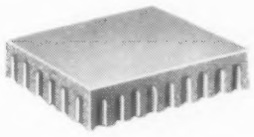
VIBRATION AND SHOCK MOUNTS

•

METAL STAMPINGS

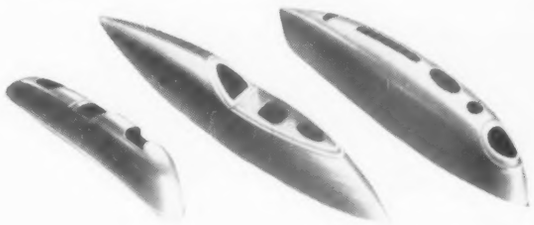
ACID DRUMS

Self-supporting all-rubber drums lined to handle Muriatic, Phosphoric, Hydrofluoric, Hydrofluosilicic acids, insecticides and caustics.



LATEX FOAM RUBBER MATTRESS

GLASS FIBER REINFORCED PLASTIC



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THE GENERAL TIRE

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COLUMBIA-SOUTHERN

INSTALLS TWO NEW

CAUSTIC SODA

SUPPLY DEPOTS

TO ASSURE YOU EVEN BETTER NATION-WIDE DELIVERY SERVICE

These two new Columbia-Southern liquid caustic soda storage depots in Chicago, Illinois, and Carteret, New Jersey, are examples of Columbia-Southern's progressive attitude on customer service.

The addition of these new storage facilities will assure continuing prompt deliveries to Columbia-Southern customers in the two market areas.

Consumers of liquid caustic soda can be serviced by tank cars from the two new areas as well as from these strategic plant sites: Barberton, Ohio; Corpus Christi, Texas; Lake Charles, Louisiana; and Natrium, West Virginia.

Deliveries to less-than-carload customers are made in tank trucks by jobbers who maintain caustic storage facilities at many points.

Specify Columbia-Southern caustic soda for a good product, fast dependable delivery, free technical assistance, courteous treatment, special care in the handling of your orders. Contact your nearest district office today.

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ONE GATEWAY CENTER, PITTSBURGH 22, PENNSYLVANIA

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